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Final Project Report

Envrionmental parameters in Urban Planning

Submitted by

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ENVIRONMENTAL PARAMETERS IN URBAN PLANNING

by

Ashutosh Bhargava

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1 - Introduction

1.0 As a positive force of economic development, urbanisation needs to be directed in such a way as to prevent or minimise some of the adverse effects of urbanisation to make it sustainable. Sustainable urban development means a combination of several factors, such as -

(i) to minimise the use of non-revenewable sources (ii) sustainable use of renewable resources (iii) keeping the absorptive balance for wastes (iv) meeting the human needs i.e. access to adequate livelihood, participation in local and national development and access to adequate shelter and healthy environment.

The role of cities in the development process is well recognised. They are productive places which make significant contribution to national economic growth. As centres for population growth, commercial and industrial activities, cities consume energy and natural resources and thus generate a variety of wastes to an extent that exceeds the assimilative capacity of urban environment. The situation is aggravated with rapid population growth leading to increased resource consumption and increased waste generation. The resulting environmental damages threaten the productivity of cities and health and quality of life of its citizens (World Bank, 1994).

1.1 Urban services (e.g., water supply, sanitation, public transport and roads) are already overloaded beyond their sustainable capacities. Increasing population, commercial and industrial activities further deteriorate urban environment in addition to poor urban management.

As a result the resources are diminished and polluted at a fast rate, posing a serious threat to the health of the cities. Cities with concentration of population and their high per capita energy consumption, contribute significantly towards the problems of global warming, acid rain, desertification and ozone layer depletion.

1.2 In the United Nations Conference on Environment and Development held at Rio de Janeiro, the countries of the World came forward with Agenda 21, an Agenda for the twenty-first century for sustainable development. It was realised that most of the problems and solutions being addressed by agenda 21 have their roots in local activities and hence the co-operation of local authorities in managing cities will be a determining factor in achieving sustainable development. Local authorities, at the level of governance close to the people, play a vital role in educating, mobilising and responding to the public to promote sustainable development. Local authorities construct , operate and maintain social and environmental infrastructure and oversee planning processes in cities. Chapter 28 of Agenda 21, also known as "suggest that by 1996 most local authorities should have undertaken a consultative process with their citizens to achieve a consensus on " a local agenda" for the community. To formulate strategies for sustainable development the local authorities would learn from local, civic community, business and industrial organisation. This process of consultation is expected to lead to an increased awareness among the citizens about local environmental issues (United Nations, 1993).

.3 Nearly 60 per cent of India's gross domestic product is produced in urban areas. Being the growth centres of the economy, cities depend upon a vast hinterland for their resources and in the process of resource exploitation generate ubiquitous pollution which damages the resources. Poverty, home lessness, crime and diseases add further to the non-sustainability of cities.

The urban environmental infrastructure plays a very important role in the development of cities. This is a medium through which resources are consumed in a city and generated wastes are disposed off. Therefore the sustainability of a city is dependent on how efficient its infrastructure is. For instance, a good water supply network in a city minimises loss of water, discourages its theft and thus leads to maximum utilisation of the resource. In promoting sustainable development of cities, the urban environmental infrastructure has to be strengthened. Inadequate or poorly managed infrastructure affects urban economic development in several ways.

- It exposes the urban population to greater health risks
- Economic productivity gets limited when services are not reliable.
- It adds financial costs to individuals and institutions for maintaining a minimum level of infrastructure.

- It creates chaos and disorder because of congestion leading to loss of productivity.
- It leads to increased consumption of resources and hence adversely affects the sustainability of cities.

1.4 Our cities are invariantly non-sustainable as they consume resources from a vast hinterland and discharge untreated wastes into the hinterland causing ecological imbalances.

Under the urban Management Programme, rapid environmental assessment was undertaken for many cities - Leitmann (1993) reports initial results of the environmental assessments conducted for a few cities. The major conclusions of such exercises were -

(i) Urban environmental degradation has a disproportionate negative impact on the poor.

(ii) Economic structure and location of economic activities shape environmental problems.

(iii) The level of urban wealth is linked to certain environmental problems - basic sanitation is a problem of low-income cities, while hazardous wastes, ambient air pollution are problems of higher income cities.

(iv) Environmental management is complex as a large number of actions are involved over many jurisdictions and government.

(v) Institutions and policies dealing with urban environmental problems are not synchronised. The capacity of local government to address local environmental problems is crucial to resultant environmental quality.

The three major notions for a desirable urban policy are -

- Improvement of urban productivity
- Poverty alleviation
- Protection of urban environment.

which leads to a more systematic inclusion of environmental issues into urban programmes and projects. In particular, meant :

a Development of environmental policies and laws;

b Incorporation of environmental concerns into economic development, planning and budgeting.

c Inter-agency co-ordination on environmental issues that cross sectoral boundaries;

d Mechanism to resolve inter agency disagreements on natural resource-use decisions;

e Operation of monitoring programmes

f Establishment of guidelines for Environmental Assessment, Provision of independent review and approval of environmental Assessments prepared by line agencies.

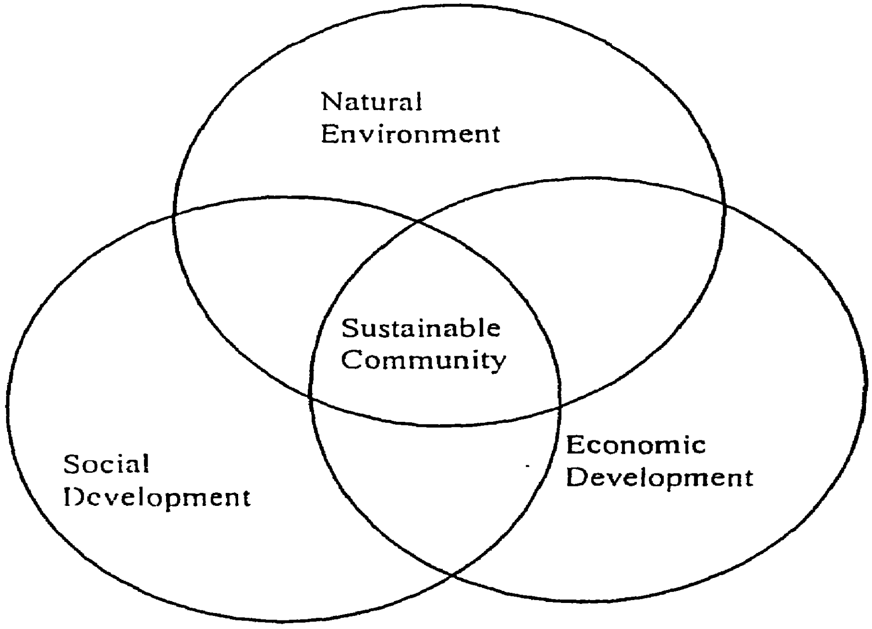
1.5 In the context of India, some recent initiations have picked up the challenge of urban environmental management and they reflect in a limited manner the growth of awareness on these issues. Urban environmental management did hardly figure in academic or official documents of the 1980's. and even the much acclaimed report of the National Commission on Urbanisation (National Planning Commission 1988) did present only a very global view on the causes of urban degradation without formulating the tools for its interceptions and reversal. Equally the Eighth Five Year Plan, which for the first time recognised the cities as an area of development intervention did not address urban environmental management. The Ministry of Environment and Forestry, in turn, has progressed considerably in formulating the Environmental Impact Assessment of New Towns (MEF 1989), the National Conservation strategy and Policy statement on Environment and Development with a particular reference to human settlements and has since 1986 been the main promoter of Ganga Action Plan including city land pollution abatement in several cities along the river Ganga. In 1994 the MEF announced the formulation of National Environmental Action Plan.

The number of voluntary organisations with an interest in the urban environment has increased substantially over the last years, active in education and public awareness creation. The most vigorous and well known of these are (i) the centre for Science and Environment which published already in the 1980s the well-known Citizen's Reports on the State of India's Environment (ii) the action and project orientated Development Alternatives group and (ii) SPARC in Bombay (iv) in Ahmedabad Study and Action group (ASAG), the Centre for Environmental Education and Vikas in Ahmedabad (v) Unnayan in Calcutta (vi) AWAS and wastewise in Banglore (vii) EXHORA in Madras as well as (viii) the Benedo Citizen's Council (BCC) to name a few.

Environmental integrity, social well being and economic viability are the three key components of urban sustainability.

Environmental Integrity.- Clean air, soil and water and a variety of species and habitats maintained through practices that ensure sustainability over the long term.

Economic Viability.- a broadly based competitive economy responsive to changing circumstances and able to attract new investments so that opportunities for employment and investment will be available in both the short and long term.



Systems perspective on sustainable communities.

√ Social well being.- Safety and health as well as equitable access to housing, regional community and neighbourhood services and recreational and cultural activities. Environmental/biophysical component should be prevalent followed in importance by the social and economic components.

Provides for a fair distribution of costs and benefits of resource use and environmental protection.

Integrative/Inter relating characteristics

Means more than just survival and implies a hierarchy of needs is adaptable to change and can be applied to determine rate of change has implications at all levels - house hold community, regional, national, international/global; the linkages between levels are important.

1.7 Process of urban planning within ecological imperatives is a call for the day. Urban planning efforts are based on a " linear " planning model which assumes that there are unlimited resources to be exploited to cater to the increasing number of people. This model was suitable for smaller populations in the past, when one-time use of goods and resources followed by discharge was practiced. These discharges when in small quantities, were within the assimilative capacity of the ecosystem and were not harmful to the environment. But with the increasing populations demanding more and more goods and resources, single use of resource followed by discharge, has led to not only scarcity of resources but also their contamination because the wastes have exceeded the assimilative capacity of urban ecosystems. Such a practice is no longer viable. There is a need to adopt a "circular" planning model which requires resource consumption with maximum efficiency, re-use and recycling to reduce the volume of waste to bring it within the self-purifying capacity of the environment.

2. Environmental Parameters in urban planning.

2.0 The present approach in urban planning ignores the environmental parameters resulting into increased urban pollution and unsustainable urban growth. These parameters are population, housing, quality & quantity of water supply, sewerage & drainage, Albedo, micro-meteorological conditions, heat-island, rainfall, temperature inversion, aerodynamics ventilation, coefficient, optimisation between concreting and non-concreting surface areas, horizontal to vertical expansion of the city, solid wastes & their disposal, transport, air quality, green and open spaces, and noise pollution. Under this project the impact of these parameters is studied with their effect on growing urbanisation.

2.1 Emerging concept in recent decade with respect to man's use and abuse of his urban environment is the realisation that whatever has been and will be produced, consumed and ultimately discarded within this resource system is still here and will continue to be here, in one form or another. The question is whether the size and degenerating capacity of the urban environment is large and responsive enough to allow sustainable economic growth and population explosion along with effluent accumulations around them without seriously impinging on the health of the people. there is a clear evidence in major cities that the answer is a resounding NO; externalities, particularly negative effects grow increasingly pervasive and as population expands and economic as well as urban growth is left to unregulated forces. Effects of environmental parameters in urban planning are show as Annexuse (1).

2.2 Physically, cities can be regarded as organisms with their own special metabolism. This special metabolism has two origins; structurally, it has heat holding capacities without parallel in the natural environment, whereas functionally, it concentrates and consumes unprecedented amount of energy (fuel, food) in small areas resulting into increasing environmental pollution. According to Abel Wolman the input-out per million urban inhabitants in a developed country are roughly as per table given below :

INPUT		OUTPUT (WASTE)	
Water	625,000 Tons	Sewage	500,000 Tons

Food	2,000 Tons	Solid Waste	2,000 Tons
FUEL:		Particulate matters	150 Tons
Coal	3,000 Tons	Sulphur dioxide	150 Tons
Oil	2,800 Tons	Nitrogen oxides	150 Tons
Gas	2,700 Tons	Carbon monoxide	450 Tons

2.3 Population.- Population density in different parts of the city and population changes in different parts over a period indicate areas requiring de-densification and densification and highlights needs for improving/strengthening social and environmental infrastructure.

Number of housing units and their spatial distribution indicate mismatch in demand and supply of housing units across the city and crowding & living conditions.

2.4 Water supply.- Sources of water supply (surface/ground) location and capacity of water treatment plants, average per capita supply in different parts of the city, areas facing acute shortage of water are important indicators. They indicate spatial availability and quantity of potable water, highlight areas having excessive consumption of water and requiring conservation measures.

2,5 Sewerage and Drainage.- Total quantity of sewerage generated in the city, location and capacity of sewage treatment plants, mode of disposal of sewage (treated/untreated, land/surface) sewerage network in the city, prominent water-logged areas, open drains, BOD and DO values for drains, stream, lakes or rivers passing through the city suggest areas in the city requiring sewerage facilities like public latrines, septic tanks & drainage facilities and treatment of sewage etc.

2.6 Transport.- Growth of vehicles and road network in the city, peak hour traffic volume on major roads, accidents on major roads, accident-prone areas and bottlenecks on different corridors, Routes of public transport, residential areas well connected with commercial centres and working areas/offices by public transport identifies roads requiring widening, better traffic management and other remedial measures in different parts of the city.

.7 **Micro-meteorological conditions:-** The modification of the urban atmospheric environment occurs in a variety of ways.

The first, is by an alteration in the nature of the reflective surface. The replacement of the natural surface of soil, grass and trees by the artificial multiplicity of urban surface of brick, concrete, glass & metal all occur at different levels above the ground.

These artificial materials change the nature of the reflecting and radiating surfaces, the neat exchange near the surface and the aerodynamic roughness of the surface.

Second, town and cities generate enormous amount of heat artificially. At certain times of the year in mid-latitude cities, articial heat input into the urban atmospheric system by combustion and metabolic processes may approach or even exceed that derived from the sun.

Third the composition of the atmosphere over cities is significantly altered by the release of emission of gaseous and solid pollutants into air. Following table provides a trend of the major change in local climate formed by cities as compared to the surrounding rural areas.

(After landsberg, 1961)

Elements:

TEMPERATURE :	
Annual Mean	1.0 to 1.5 higher
Winter mean	2.0 to 3.0 F higher
RELATIVE HUMIDITY:	
Annual mean	6 per cent lower
Winter	2 per cent lower
Summer	8 per cent lower
Dust Particles:	10 times more
Cloudiness	

Fog, Winter	100 per cent more
Fog summer	30 per cent more

RADIATION:

Total on horizontal surface	15.6 to 20 per cent less
U.V. Winter	30 per cent less
U.V. Summer	5 per cent less

Wind Speed:

Annual Mean	20 to 30 per cent lower
Extreme gust	10 to 20 per cent lower
Calms	5 to 20 per cent more

Precipitation	5 to 10 per cent more.

2.8 Wind speed, wind direction, solar radiation, temperature, humidity are the governing micro-meteorological parameters which should determine important strategies used in the process of policy initiatives for urban development. But practically or in reality, these policy parameters are not used in urban planning, partly due to the ignorance of their importance and partly due to the technological limitations along with lack of infrastructure back-up.

Some of these parameters are in the form of wind roses, ventilation coefficient, heat island, temperature inversion, albedo, mixing height and rainfall.

Functional Elements of micro meteorological conditions have been reflected as annexure-2.

2.9 **Wind Roses:-**

Wind roses are the graphical presentation of percentage frequency distribution of different wind speeds and direction classes. They act as an important tool in defining zoning of areas having regard to critical conditions for summer and winter seasons. The entire layout of the urban planning should preferably be based on the pattern of the winds which is reflected through the wind roses.

The flow of wind over an urban area differs in several respects from that over the surrounding countryside. These differences occur because the surface of a built up city is much rougher than that of rural terrain exerting increased frictional dray on air flowing over it and because the heat island of the city caused horizontal gradient, especially near the city periphey. The excessive heat and friction also produce more turbulence over the urban area (landsberg):

The critical value of wind speed that determined whether the urban wind will be faster or slower than those of the country side is highest during the summer nights and during both day and night in winter. These are signs of relatively higher atmospheric stability. The lowest value of critical speed occur during summer and fall days. More over the magnitude of the decrease in Urban wind speed is greater during spring days, and least during spring nights. Wind speed in the centre of city is lower than one in the suburban areas.

Planning and Zoning:-

Proper planning and Zoning of industrial and residential areas play an important role in the control of air pollution, Prime importance must be given for locating sufficient number of public parks and gardens. In Zoning of land of residential and other sensitive areas, wind directions, speed and frequency of prevailing wind should be given due consideration. The topography of area should also be considered.

.10 Ventilation coefficient:-

While urban layout is planned, care is to be taken to ensure effective ventilation. In other words, the predominant winds must have flushing effect along the roads and the streets and there should not be any obstruction which reduces the ventilation coefficient in the urban area. The pollutants so generated on the streets or roads due to automobiles and domestic fuel burning are required to be transported through the winds so that air pollution does not accumulate. Thus, there is a need to provide effective ventilation coefficient by effectively designing urban layout.

The suitability of a particular location for industrial developments depends partly upon the ability of the atmosphere of the region to disperse and dilute pollutants. The pollution potential of a location is usually measured in terms of the mixing heights and wind speeds (ventilation coefficient = mixing height x mean wind speed). Using the holzworth method (1967), early morning and after-noon mixing heights (heights upto which air can effectively act as a mixing agent capable of transporting the pollutants) and ventilation coefficients can be computed for certain years. India is a monsoonal country and four typical seasons North-East monsoon (winter from Dec. to Feb.); Pre-monsoon (summer from March to May), Monsoon (Rainy from June to mid-september and post Monsoon from mid september to November may be identified. The maximum mixing heights are found to be highest in the month of April and lowest values are found in the month of October. The regions with high mixing heights can be viewed favourably for industrial location. The increase fog frequency in areas having low ventilation coefficient represent poor dispersal of pollutants in these areas.

2.11 Heat Island:-

Heat Island is a phenomenon which is associated with the urban environment. It is attributed on account of the increased release of carbon dioxide into urban atmosphere and imbalance caused in the ration of incoming and outgoing solar radiation. It has been witnessed and reported that the surface temperatures in rural areas are significantly less as compared to temperatures in urban areas.

The fact that some places are warmer in a city than their surroundings forming a heat island is well known. The intensity, area, shape and position of warm pockets depends upon the topography, urban morphology, wind speed & direction, intensity and depth of surface inversion etc. To study the heat island effect close net-work of observatories needs to be established so that simultaneous observation can be made at all points. It is interesting to note that surveys have brought out cooler land temperatures at adjoining well ventilated & comparatively open areas. There are distinct heat islands over thickly populated commercial and Industrial areas. The heat balance is also disturbed due to anthropogenic activities producing large quantities of green house gases.

Heat island is an important conceptual parameter which is required to be taken care of as the air pollutants released through automobiles or other household fuel burning process get activated due to high temperatures and become comparatively more reactive.

These activated particles in sub-micron size are inhaled by the human beings resulting into adverse heath effects. Functional elements are shown in annexure-2.

During this century major cities have been expanding and resulting into excessive warming is well correlated with the city growth rate.

Heat Island also depend upon the various meteorological parameters as night wind speed and cloud cover are the most important variables for determining the heat island magnitude.

- wind speed
- wind direction
- cloud amount.

FORMATION OF AN URBAN HEAT ISLAND: (seasonally dependent):-

There are two processes involved in the information of an urban heat island, both are seasonally dependent.

FIRST:-
In summer the tall buildings, pavements and conerete of inner city absorb and store large amount of radiation (because of their geometry and high thermal admittances) than the vegetation and soil of rural areas. In addition much less of this energy is used for evaporation of water in the city than in the country side because of the large and speedy runoff or precipitation from streets and building. At night, while the city and country side both cool by radiative losses, the urban man made construction materially gradually gives off the additional heat accumulated during the day, keeping urban air warmer than that of the rural areas.

SECOND:-
In winter a different process dominates. Since the sun angle at mid latitudes is low and lesser amounts of solar radiation reach the earth, man made energy becomes a significant addition to solar energy which is received, Artificial heat results mainly from conbustion of fuel & power generation industry, transportation and other anthropogenic sources.

OTHER FACTORS FOR CAUSES OF HEAT ISLAND

AIR BORNE POLLUTANTS:-

Pollutants over a city, including particulates, water vapour CO2 & other gases of anthropogenic origin absorb part of the up ward directed thermal radiation emitted at the surface. Part of this radiation is remitted downward and retained by the ground; another part warms the ambient air, a process that tends to increase the low level atmospheric stability over the city, enhancing the probability of higher pollutant concentration. This air born pollutant concentration causes a more intense heat island.

WIND SPEED:-

Reduced wind speed within an urban area as result of the roughness of the surface decrease the city's ventilation, inhibiting the movement of cooler outside air over the city centre and the evaporation process within the city.

2.12 Temperature inversion:-

Temperature inversion is the phenomenon which is usually applied to winter conditions when the temperature instead of decreasing increases with height. This phenomenon is prevalent in urban areas leading to high degree of air pollution and consequential advverse health effects.

During inversion vertical air movement is stopped and pollution will be concentrated beneath the inversion layer i.e. the denser air at ground level. As a result during temp. inversion, the atmosphere is stable and very little turbulence occur in the atmosphere.

Inversion is a frequent occurrence in the autumn and winter months and the accumulation of smoke and other contaminants further aggravate pollution by preventing the sun's rays from warming the ground and the adjacent air. Fog in the metropolitan city in a very common example. At the time of inversion visibility in greatly reduced and contaminants are maximum.

2.13 Mixing height:-

It is the height to which the air can act as a mixing agent and capable of transporting or lifting the air pollutants generated from various sources.

This conceptual phenomenon is important in determining the vertical expansion of the city and also helps not to allow accumulation of air pollutants.

It is the height above the earth's surface to which related pollutants will extend, primarily through the action of atmospheric turbulence. It is dependent upon these factors.
(i) Wind Direction
(ii) Wind Speed
(iii) Wind turbulence.

4 **Rainfall:-**
Rainfall is an important parameter and is to be associated with the concreting surface resulting into run off and consequential impact on the natural drains and other receptor media.

The urban layout should be such that the runoff should be taken care of by the open space provided for recharging the ground water in a well defined grid system.

A city also influences the occurrence and amount of rainfall in its vicinity. Due to various reasons an urban area might be expected to receive increased rainfall. Combustion sources, (burning of fuel, word etc. in home etc.) addition to the amount of water vapour in the atmosphere, increased temp., intensified thermal convection, greater surface roughness increased mechanical turbulence and greater concentration of condensation nuclei, precipitation over a city is about 10% greater than that over nearby country areas. (landsberg 1968).

5 **Albedo:-**
Researchers have calculated that a unit increase in the earth albedo (reflective surface characteristics) will cause a decrease in average surface temperature of 1.8 F.

Densely built up regions have a higher albedo than the forest and cultivated soils. This phenomenon can change the weather and climate and may have impact on the generation of air pollutants in the urban areas.

roads should be increased in the city i.e. increasing in carrying capacity of roads.

The traffic congestion and resulting air pollution may be reduced if the various markets and commercial places are decentralised and shifted elsewhere from the main city centre. Besides, regular inspection of vehicles and the rectification of engines is necessary to minimise the problem.

Functional Elements of Transportation have been reflected in annexure-3.

Carrying capacity of Roads.- This conceptual parameter is reasonably important and needs to be determined or rather planned for future urban development to ensure free flow of traffic. If the carrying capacity of a particular road is not adequate it restricts the free flow of the vehicles, thereby reduces the speed and on the other hand increases automobile air pollution load in the urban atmosphere. Functional elements of this aspect is reflected in annexure-3.

This important concept needs to be incorporated in laying roads in the process of urban planning.

Emergence of vehicular growth:-

With the rapid growth of urban development, increasing number of vehicles is resulting into increasing air pollution load into urban atmosphere.

The time variable trends with respect to emergence of vehicular growth needs to be developed and its application be made in urban planning and designing of road network.

Traffic pattern:-

This aspect needs to be studied in detail and shortcomings thereof should be identified so that mitigating measures may be employed in process of planning.

Regular emission checks:-

In order to ensure that the vehicles are properly maintained and remain in good condition, emission checks should be regulated effectively, partly to economise the fuel consumption and partly to reduce the air pollution load in the urban atmosphere. Vehicles emitting higher air pollution than the permissible norms should not be allowed to ply on the roads.

The efficiency of this system needs to be assessed along with the provision of random checks by some identified and qualified ndependent authority to assess the correctness of the certificates being issued by concerned agencies. Formation of a reference aboratory in this regard may also be thought of. An integrated system needs to be evolved in this area.

An urban transport system has to ensure efficient mobility of the people at low cost and reduce transportation costs in terms of energy, time pollution and accidents. The limitations of increasing he road capacity (by widening) for intra-urban travels for the remendous growth in private vehicles point to the desirability of diverting intra-urban travel to strengthened public transport system. Along with public transport system steps should also be taken to reduce pressure on the transport system by developing economies of he small towns. Land use planning can be used as an instrument of urban transport planning in that restructuring of land use can lead to better distribution of trips.

Waste water & solid waste.-

Various components relating to waste water & solid waste have been shown in Annexure 4 and 5. Functional elements of sewage management have been indicated in Annexure 4 whereas those of solid waste are reflected in Annexure 5.

Functional elements of sewage management.- With the growth of urban development and consequent increase of water supply, sewage generation poses serious problem.

This aspect needs to be tackled in the process of urban planning. A well defined sewerage system is required to be designed keeping in view the drainage system of the urban area.

The sewage so generated is to be effectively collected through the well defined sewerage system and treatment is required to be given to remove the pollutants. The treated effluent should be utilised either in irrigation or development of green belt. Forestry and greening of hills can also be considered by the utilisation of treated effluents. The urban planning should be such as to make sure that this treated effluent is considered as resource material and should be effectively utilised in above areas of application.

Sludge generated from the treatment of sewage should be utilised either in generating energy or manufacturing of compost. It should not be dumped to cause groundwater contamination. If it is to be disposed of, it should be through the sanitary land filling.

Emerging Technologies for Sewage Treatment.- Domestic sewage constitute a major source of pollution especially of aquatic bodies as sewage generated in urban communities are discharged either without or with partial treatment. Several factors are responsible for inadequate treatment technologies e.g. Activated sludge process, extended aeration system and low return on capital investment to build treatment plant facilities. To over come these problem some emerging technologies are :-

(i) Duckweed - pond technology
(ii) Vermiculture technology
(iii) Root Zone Technology

These technologies are based on rational system and advantages are :

(i) Minimum use of mechanical equipment
(ii) More eco friendly
(iii) Capable of generating revenue.

Duckweed pond Technology.- The duckweed pond is an earthern basin, preferably lined where duckweed plant grows and cover the entire water surface. Since this floating aquatic plant is very small, it can be easily swept off from the water surface to one side by wind or waves. Such a uniform cover of duckweed cuts off penetration of sunlight into the water thereby eliminating growth of algae and aquatic plants which could have consumed the nutrients. Duckweed cover is also effective in suppressing odours and eliminating mosquito breeding. The duckweed can also be dried or converted into pallets for use as feed for chicken and cattle.

In the duckweed pond both anaerobic reaction and activity of duckweed are responsible for removal of carbonaceous matter as well as nutrients and trace metals, if any.

Vermiculture Technology:-
This technology utilises earth worm for the treatment of domestic sewage. The earth worm have been called as rational bioactor. The earth worm produces both microorganism and enzymes that breakdown complex bio-molcules into simple compounds which are utilised by microorganism. In this method a 90 cm. layer of active biomass of earthworms supported on sand and coarse aggregates is used for treatment. The sewage is distributed on earth worm layer which extract the contaminants and treat the sewage. The earth worm producing vermicastings with immobilised microflora and nutrients have the potential of being used as biofertiliser.

Root Zone Technology:-
The root zone technology is also referred to as artificial wet land system. Waste water or sewage is kept at or above the soil surface for enough time during the year to maintain saturation condition. Basic principle behind this is that weeds have an oxygen transport system from the leaves to the roots that permits the roots to survive n anaerobic condition prevailing in a swamp. The oxygen supplied o hollow root zone called rhyzome is available to the aerobic bacteria growing in sewage. This bacteria breaksdown the organic matter present in the sewage in a manner similar to the conventional aerated lagoon.

The process is, in essence, nature's answer to the modern, ndustrialised world's pollution problems and may greatly help in solving most sewage treatment problems in the country in future. Developed in the sixties in Germany, the Root Zone Process has been today fully commercialised to treat industrial and domestic effluents - economically, efficiently and naturally.

Three integrated components are essential to the system - the reeds, he reed bed and the microbial organisms. The system developed involves simply running contaminated water underground through the root zones of specially designed reed beds. The reeds and the reed bed together create beneath the surface of the soil an outstandingly efficient effluent treatment factory. What is released is water that has been made environmentally acceptable by a natural process.

Bio diversity is the key to the Root Zone Process. More than 2000 types of bacteria and tens of thousands of fungi exist in the reed bed. These microbial organisms oxidise impurities in the waste waters. Since the process occurs underground, aerobic and anaerobic zones exist side by side, inducing different types of chemical reactions and balancing bacterial growth thus decomposing the contaminants to their basic forms.

Phosphates, sulfur compounds, nitrogenous materials are reduced to their elemental forms, while BOD and COD are drastically brought down. Heavy metals precipitate from solution and are bound into the soil matrix. What comes out of this constructed marsh is treated waste water which is not only environmentally acceptable but much cleaner than possible with any other technique.

The capital cost of the root zone system is roughly half that of conventional systems while operation and maintenance costs are just one fifth. The technology has the potential to reduce treatment and costs considerably and, therefore, may gain wide application.
Advantages:

No requirement of energy and mechanical equipment
maintenance free
system can provide rational habitat for faunas.

Treated effluent :-
Treated effluent released from the treatment plant can be used in various way like for irrigation, green belt development & Forestry.

Functional Elements of Solid Waste Management Systems:
With the rapid growth of urban development generation of solid waste is increasing day by day. In the urban planning system special stress needs to be given to the effective collection of such waste in a well defined grid system. Bio degradable and non-degradable waste

be segregated and then transported at a preidentified site for the ›ose of storage. However, prior to storage, site needs to be ared so that leachates may not contaminate the ground water. tment is to be given to solid waste either for the generation of gy or manufacturing of compost. It is to be disposed off by way anitary land filling. In the process of urban planning efforts ıld be made to make use of these wastes which can be converted usable products like energy, compost etc.

gating problems of Solid waste :-

problem of waste could be mitigated through the adoption of oved methods of collection and transportation. Scientific and onment friendly technologies for treatment and processing of e will reduce the quantity of waste to be finally dumped besides rating a substantial amount of energy.

technology options available for generation of energy and ırces from solid waste materials can be classified into two d categories. One as biological options including composting, ıicomposting and anaerobic digestion and the other, thermal ›ns which include processes such as incineration, production of .e derived fuel pellets, gasification etc.

posting is the decomposition and stabilization of solid organic e materials with the help of aerobic micro organisms. This ess yields a product that contains nutrients and micro nutrients ıtial for the healthy growth of plants. Both municipal and strial solid wastes can be treated by this method. Composting be either manual or mechanical. The different stages in a ıanical compost plant are dumping of refuse on a conveyor m, removal of plastics, glass and other debris on a picking belt, eduction, decomposition of the refuse, storage and disposal.

compost thus produced can be marketed and it has a potential rn profit. This is evident from the example of Excel Industries, bai, which is currently producing and marketing compost the brand name of Cell Rich. They have projects in operation lumbai, Ahemdabad, Bhopal and Gwalior, Projects under ımentation are located at Calcutta, Thane, Kanpur, Jaipur, wada and Shimla. Operating parameters of their compost as on April 1994 are

Volume of garbage : 450 m3/day, which is unsorted and mixed type and weighs garbage 300 TPD (tonnes per day).

Preparation time: 45 days, before the garbage is ready for composting.

Useful mass output: 100 TPD, i.e. 35% of the garbage can be used for composting after sorting.

Total land required: 6 hectares for the process of composting.
Capital investment: Rs. 250 lakh (excluding land cost)
Value of product: Rs.1300/tonnes

Thus the problem of waste can be tackled in a much better way, by deriving some financial benefits out of it, besides the environmental benefits, as the natural resources can be returned to the soil

.19 Urban Land use pattern :-

Some of the policy initiatives as reflected in annexure-1 are optimization of concreting and non-concreting surface area, optimization of vertical to horizontal expansion of the city, zoning of land use activities, and urban green belt development. These parameters need to be infused in the process of urban planning.

Functional elements of urban land use pattern are indicated in annexure-6 which inter-alia primarily consists of land use development and its inter-dependence on land use classification. Industrial, commercial, residential, sensitive and open spaces etc. are indicated as the main areas of land use classification for which environmentally compatible zoning is required to be planned having regard to conceptual parameters in the form of ventilation coefficient, wind roses and drainage system.

The quality of urban environment is to an extent determined by the physical pattern of land uses, distribution of population and services networks. Open spaces fulfill crucial functions.

2.20 Optimization of Concreting and non-concreting surface area:-

This is an important aspect which needs to be considered partly to ensure effective recharge of the urban ground water by providing open spaces at reasonably equal intervals between the concreting surface and partly to neutralise with green cover, it may also acts as an effective scavenger for the absorpation of air pollutants.

Promotion of the reuse of vacant and derelict land reduces pressure for development of green field sites.

2.21 Industrial Zoning :-

Unplanned and haphazard siting of industries might substantially increase the risk to the environment. presently the proposed site for starting an industry is cleared from environmental angle after reviewing its pollution potential and probable impact on environment by the state pollution control boards and the state government's environment committees. Saite may turn out to be either suitable or unsuitable. However in the present arrangement combined treatment or disposal facilities cannot be provided & pollution control cannot be properly due to haphazard development.

Land zoning for siting of industries classifies the environment in a district and presents the pollution receiving potential of various zones in the district which provides a basis for incorporating environmental aspects into land use planning. Preparing industrial zoning atlas for a district can be broadly categorised in six steps an given below:-

1. Preparation of the basic map of the district.

2. Preparation of themes which show the physical features of the district (land use map, drainage, physiography, land capability etc.)

3. Identification of areas showing sensitive zone which are unsuitable for industrial siting from environmental consideration/guidelines, legal restrictions and physical constraints. The concept of wind roses can be utilised for eliminating areas where industries may not be allowed in proximity of an urban area on grounds of wind directions, speeds and frequencies.

4. Preparation of theme maps pertaining to air pollution sensitivity, surface water pollution sensitivity and ground water pollution sensitivity.

5. Preparation of pollution sensitivity maps based on over-lay of theme maps identification of

(a) Possible alternate site for location of industries based on the sensitivity of sites to air and water pollution and, the risks associated with the industrial site and,

(b) Possible solid waste disposal sites based on sensitivity to ground water pollution.

Listing of categories of industries suitable to various zones identified and providing guidelines for siting of industries and site clearance procedure. Thus Industrial zones can be categorised where various type of polluting industries can be set up in groups. While selecting such areas preference is to be given to waste lands. Sensitive area and residential areas can also be earmarked on environmental aspects for overall land use planning by preparing sub-atlus for the urbanizable limits of cities. Such macro-level aspects require micro-level planning by more detailed studies.

2 **Optimization of Vertical to horizontal expansion expansion of the city:**
This is also an important parameter which needs to be incorporated in the planning process with a view to have effective dispersion of pollutants, proper distribution of pollutional load, effective air ventilation, charging of ground water etc.

3 **Urban Green Belt development :-**
Green belt in urban areas all along the roads and the city area is required to be planned partly to provide cooling effect and partly to provide effective scavenger for the absorption of air pollutants and reduction of nose levels. A well developed green belt around the industrial areas attenuate fugitive emissions, odours and noise besides creating aesthetically desirable surroundings.

.24 Natural Drainage Systems

The tendency in contemporary town planning practices is to subjugate the natural systems to human needs. Major changes are made in the natural terrain by moving earth to meet the requirements of the city. Advantages of natural features like land outcrops, water bodies and water courses is often not taken. This leads to dislocation of drainage and other natural balancing systems. In any landscape, natural water courses or drains constitute an extremely important environmental features. The water courses drain out the excess rain water into the rivers and prevent the land from getting waterlogged and flooding. One of the biggest casualities in contemporary planning practices is natural drainage. They are generally left as incidental open spaces without any specified land use. Housing and other types of development come up on both sides of the water courses generally facing the other way, making the water courses look like the backyards of the city. Some times under pressure of development water courses are filled up and built upon, choking the natural drainage of the city. The low lying areas abutting the water courses gradually get encroached upon. The city waste is indiscriminately discharged in the water courses and soon the water courses acquire the name "dirty drain". The slums on the low-lying areas prone to water logging create human problems and the abuse of the water courses creates environmental problems for the city. The solution lies in recognising the water courses as prestigious civic areas instead of the backyard of cities. The network of water courses and certain areas indentified on either side of them should be developed into the main civic forested landscape. The forested network of water courses can be integrated with the waste water treatment system. Roads should be so designed as to support and strengthen the natural drainage.

.25 Green spaces:-

Location and areas of forest, public parks and other green spaces in the city and temporal variation in the green cover of the city indicate action for saving trees in certain pockets of the city and areas devoid of any vegetation.

2.26 Air Pollution:-

Ambient air quality in the city (at different monitoring stations), emissions from transport sector identifying polluted corridors during peak hours indicate delineation of areas exceeding 'prescribed' air quality standards. Measures to reduce air pollution menace on polluted corridors can also be inferred. Similarly emissions from air polluting industries and prevailing wind direction affected areas by industrial air pollution can indicate use of appropriate technology to reduce industrial air pollution and industrial zoning.

2.27 Noise Pollution:-

Ambient noise levels in commercial, industrial and residential areas and near hospitals peak hour noise levels at major roads intersection help to identify the causes of noise pollution in different areas and to evolve measures for reducing them.

2.28 URBAN ENVIRONMENTAL MAPS:-

Showing spatial distribution of environmental infrastructure and environmental parameters in different parts of the city may help evolve an action plans for directing urbanisation in the desirable manner. While maps on each aspect of such as population, housing, water supply, sewerage, drainage, solid waste, air and water and noise pollution are useful by themselves these become much more meaningful when super imposed on land use, population and transport maps and maps showing industrial and commercial activities. Lack of information, out dated information base, lack of uniformity of data however limit the utility of these maps.

2.29 Citical Urbanisation Limit - Index :-

There has been a major change in the organization of major industrial societies within the last thirty years.

The modern urban facility has become so sophisticated that their carrying capacity is at times showing an upward trend. But all cities produce a certain minimum amount of industrial and biological waste. This has an adverse effect on the sustainable development of urban areas and its support system in the rural hinter land.

The critical urbanisational limit index can provide signals to the town and city planners at different permissible levels for expansion.

There are there essential parameters for obtaining the critical urbanisation limit index.

(i) Heat Absorption surface
(ii) Heat Radiation surface
(iii) Population density
(i) Heat absorption surface : It include; water foliaged vegetable, grassfield, soil, etc.

Water surface is the most effective heat absorber as compared to all other surface; viz. Reservoirs, opentanks, lakes, rivers, & tree foliage. The tree leaves are best heat dissipater;

(ii) Heat Radiation Surface :

Metallic surface area : urban complexes one the major consumer of our metallic output. The roof made up of iron sheets, bridges, railways towers, poles, fence etc. also contribute to metallic surface of urban layout.

(ii) Metalled roads form a significant portion of our urban land area.
(iii) Structures of cement and concrete are the largest surface areas built by man.
(iv) Stone is the most ancient and the most commonly used material for urban structures.

(iii) Population Density : The urban population density can also be expressed in terms of residential density.

The density ranges for planning are given below :-

Low	Upto 125 persons per hectare
Medium	126 - 250 person per hectare
Medium High	251 - 400 person per hectare
High	401 - 600 person per hectare

The critical urbanisational index in fact is the resultant of total absorption capacity of various surface areas divided by the total radiation capacity of various surface areas and multiplied by medium population density taken as one.

$$\frac{\text{Absorption Capacity Area}}{\text{Radiation Capacity Area}}$$

$$\text{index} = \frac{\text{ACA}}{\text{RCA}} \times 1 = \text{Critical Urbanisationalimitindex}$$

If the value of index ranges between 0.1 and 0.3 the city is given the green signal for its expansion. In case the value of the index is 0.4 or little above the expansion signal is yellow. This is the stage when limit could easily be pulled down to a green level through corrective measures.

If the value of index is 0.5 or more the city is given the red signal. At this stage the pollution level in the city may be such as is not easily reversible. In case the city or a town has crossed 0.6 to 0.7 index, this is a condition which can be corrected through natural calamities by destruction.

In this index the industrial discharges causing a substantial damage to urban and hinterland eco system has not be taken into account because such parameters can not easily quantified.

Environmental costs :-

In Most of the Indian cities with million - Plus populations, air pollution levels exceed WHO recommended standard-and almost every city the levels are getting worse because of the growing population growing number of vehicles, energy consupmtion, unbridled industrialization and waste.

A study completed by two world bank staffers carter Brandon and Kirsten Hommann (B$H) - The cost of inaction : Valuing the economy - vide cost of environmental degradation in India estimates that environmental damages amounted to a total of US $ 9.7 billion per year or 4.5% of the GDP of India. Such costs include impact on Health, productivity losses, soil degradation, range land degradation, deforestation, decline in tourism revenues etc.

Thus sustainable urban development requires not only adequate land supply and but detailed environmental action plans. Rapid urban Environmental assessment and consultation, urban environmental management strategy, urban environmental Action plan and Environmental Investment programmes are the four stages of sustainable urban development. Thus the sustainable urban development can be formulated as SUD = L + E.P. + F + NI which means land plus environmental planning plus Finance plus Network infrastructure creates the physical foundation for sustainable urban development.

3- ENVINRONMENTAL PARAMETERS- PLANNING OF JAIPUR REGION

3.1 INTRODUCTION:-

Jaipur, the Pink City of India, famous for its beauty and architectural grandeur is one of the few planned cities in the world City was founded in the year 1727 by Maharaja Sawai Jai Singh-II as the capital of his State to shift his old capital from Amber which had been the seat of his ancestors for centuries. Most of the physical development of this new capital took place before 1800 A.D. The beginning of Sawai Man Singh II's reign brought the modernisation of Jaipur City. Major land development schemes outside the walled city were taken up after Sir Mirza Ismail took over as Dewan of Jaipur in 1942.

Jaipur is located on 26 degrees 55 minutes north laditude and 75 degrees 50 minutes east longitude at 382 to 462 above mean sea level. Geomorphologically Jaipur region has been divided into three geomorphic units i.e. the recent Alluvial plain region, the Delhi super group region, the Aravali super group region..

Jaipur is easily accessible by roads, railways and airways to rest of the country. The city lies on Delhi-Ahmedabad meter-gauge of western railways (it is in the process of conversion to broad gauge). The N.H. No.8 and N.H. No.11 intersect at Jaipur and N.H. 12 leading to Jabalpur starts from Jaipur. City is situated at a distance of about 650 Kms from Ahmedabad. The city is well connected by air also and the Sanganer Airport is located at the southern end of the city which is proposed to be converted in to an International Airport.

Jaipur city is surrounded by Aravali hills in the north and east directions. Three major hills ranges belonging to Aravali system exist in Jaipur. These are known by different names such as (1) Taramati hills situated west of Sabi and Banganga rivers (2) Range starting from Sambhar lake and crossing over to Singhana in Jhunjhunu district and (3) Puranaghat, Nahargarh, Jhalana and Ambagarh hills.

The region is drained by a number of seasonal rivers of which Banganga, Dhundh and Bandi are prominent. Banganga has been impounded near Jamwa Ramgarh by Ramgarh dam.

A study of Regional slopes indicates that Amani Shah Nala towards west and south of the city area forms a major drainage system which flows to meet Dhundh river towards south-east of Jaipur City. The areas in north west have various local drain slopes which join together to form Bandi river situated towards south west of the city. The northern area converage through local drainage slopes to form Banganga river which flows towards east. Bandi river has two major reservoir basins known as Kalakh Sagar towards west of Jaipur Region and Hingonia Sagar towards South-west. The land in south and west of the walled city is flat and hence the city has experienced most of its expansion in these direction in these directions. The walled city is having an area of 6 Sq. Kms. Total area of city is approx. 200 Sq. Kms. The area of Jaipur Development region is approx. 1464 Sq. Kms.

Jaipur was planned according to the "Prastra" type (Grind pattern) of layout, having prominence to cardinal directions with gates of sun (Surajpole) and moon (Chandpole) forming the central axis of the city. The central axis is crossed by three roads at right angles dividing the city into nine blocks which has been further subdivided by lanes and alleys with central placement of Royal Palace.

MICRO-METEOROLOGICAL CONDITIONS:-

Meteorology plays an important role in evaluating and assessing the prediction of air pollutants already released or likely to be released from the existing as well as from the proposed industrial operations and other developmental activities.

It also helps in designing and computing urban plan with input of environmental considerations.

Meteorology is considered to be important for fixing various environmental indices in the valuation and assessment of urban air polution.

The normal climate of Jaipur City is hot and dry with experience of extremes of heat and cold in summers and winters respectively. The mean maximum temperature of Jaipur is 41 degrees and the mean minimum temperature is 6.5 degrees. As Jaipur lies between the Nahargarh and Jhalana hill ranges, meteorological phenomenon called inversion of temperature occurs.

The average annual rainfall is 62 cm, nearly 90% of which occurs during the summer monsoon. The higher relative humidity of about 74% is experienced during the month of August which is a month of maximum rainfall and the lowest relaltive humidity is experienced in the Month of April and May.

Jaipur area has experienced an emergence of environmental crisis in terms of depletion of water, forest and soil cover, flora and fauna and climatological changes. The whole area towards east has experienced substantial deforestation. This is further deteriorated due to mining operations for building stones. At regional level the upper Banganga valley is slowly turning into a deforested patch. Devastation of the tree and soil cover has turned hilly areas to rocky exposures. Silting of Ramgarh Dam and upper river channel of Banganga has been the result of wide spread deforestation in the upper river basin. Salivation process is generating saline waste lands around Sambhar Salt Lake, waste lands are also expanding. Jaipur has also recorded ~~increase~~ in sandy waste land due to strong dust storms and drifting of sand from the gap in areas located on the western boundary of the district on Aravali hill range. A large concentration of sand features can be observed across the gaps in the district stretching right up to Jhalana-Dungari area of Jaipur.

The resultant impact of the deforestation, erosion, siltation, salination processes has created environmental changes in the eco-system and their subsystems. This is affecting the recharge of ground water resulting in lowering of water table every year. It has also effected the microclimate of the region in terms of temperature and humidity.

WIND ROSES:-

Wind rose is symbolic representation of the percentage frequency distribution of different speed class and distribution. The central part of the diagram represents calm conditions which in fact is not calm, but signifies that the wind speed is low of the magnitude of less than 1 Km./hour. lUsually 16 directions are taken for working out percentage frequency of the different speed class. Thus, the wind rose diagram represent not only the directional representation but also indicate sectoral representation.

Wind roses of Jaipur has been prepared for summer winter and annual basis and are superimposed on the land use map of Jaipur as shown on monthly and seasonal basis. Annual wind roses have also been prepared as presented in Annexure-7. The data relating to wind speed and directions have been collected from the Indian Meteorological Department and percentage frequency distribution of different wind speed and direction classes has been done by the State Pollution Control Board.

It would be evident from figure 7 that the Vishwa Karma and Jhotwara Industrial areas are located in the north-west sector with respect to residential areas whereas Malviya Industrial area is located in the south-east sector. In other word, the location of Vishwa karma Industrial area and Jhotwara Industrial Area do no appear to be environmentally compatible as the emissions from thses industrial areas may tend to be transported in the residential areas which is conceptually wrong.

It would be evident from annexure 8 that east (E) is the predominant wind direction in the months of January to march where as in April, north (n) is the predominant wind direction.

Similarly north-east (N-E) is the predominent wind sector in January March, South-West (S-W) in February, and north-west (N-W) in April. Least Occurrence of winds are from S-W in all the four months.

Annexure-9 indicates predominant wind directions as North (N) and north west (NW) in the months May and June to August respectively whereas north-west is the predominent wind sector in all the four months. least occurrence of winds are from south-east (S-E) sector.

Similarly, annexure-10 reveal the fact that NW, N, and E are the predominent wind direction in the months September, October, November and December respectively.

Predominent wind sectors are N-W and N-E in the months September and October to December Respectively.

Comparing the monthly wind roses, it tends to indicate that maximum occurrence of calm conditions are in the month of November (47.89%) and least (20.16%) in the months of August. Predominent wind sectors are N-E is the month of October to January (4 months) and March, S-W in February, and N-W in April to September (6 Months). Least occurrence of winds are from S-W sector in the months September to march (7 months) and S-E sector in the remaining months of April to August (5 months).

Seasonal and annual wind roses are presented in annexure 11

which tends to indicate N-W as predominent wind sector for monsoon and summer and N-E for winter.

On annual basis, N-W is the predominent wind sector followed by N-E, S-E and S-W. Occurrence of calm condition are maximum in winter (37.60%) followed by summer (35.25%) and monsoon (32.32%).

The above explanation terds to indicate that north-east (N-E) sector is comparatively safe for locating residential areas and other sensitive features with reference to industrial areas and potentially hazardous installation, and activities.

The above explanation indicates the role of wind roses in urban planning and also in defining the zoning of various land use activities.

Ventilation coefficient:-

In the context of Jaipur the ventilation coefficient with the present growth of urban development is satisfactory. But with the vertical expansion of the city, in times to come urbanisation may reduce the air ventilation. It may also be affected by unplanned development restricting the flow of the winds.

Heat Island :-

The heat island effect in Jaipur city has been noticed. The temperatures were recorded at different locations in the city and outside the city at different times - though not on regular intervals.

It has been reported that in the city of Jaipur, there has been an increase of 10 C in highly dense urban areas i.e., the walled city as compared to the temperatures recorded in the middle of Golf Club in Rambagh area. This witnesses the emergence of heat island phenomenon in Jaipur.

It is strongly recommended that a controlled proportion should be kept between the concreting and non-concreting surfaces in the process of urban planning so that effect due to albedo can be taken care of. It is further recommended that all the open spaces kept for parks, recreational facilities, public places, roads etc. are to be provided with extensive plantation in order to minimise the occurrence of heat islands. The north-easterly winds are also equally predominant would influence the south-west sector from rough areas source of walled city. The two green patches (Rambagh & Ramniwas Graden) which falls in the south-west sector with respect to walled city have an important contribution in the process of scavanging of air pollution, noise pollution and to a great extent restrict the occurrence of heat island phenomenon in its gravity.

Temperature inversion :-

In the city of Jaipur the phenomenon is reported to be evident during winter conditions and the pollutants are visible in the form of layer of smoke above the urban area.

Mixing Height:-

In the context of Jaipur city, the vertical expansion as yet is not to that extent which influences mixing height. However unplanned & uncontrolled construction of high rise buildings might affect mixing height and due care is to be taken in this regard for future development.

Rainfall :-

The city of Jaipur has witnessed the high rainfall and alarming run off resulting into floods and shearing of loose soil which had created havoc in the OTC and Amba Bari areas in early eighties.

Thus this aspect is to be considered in association with the extent of concreting surface which can be provided in urban areas so that ground water is effectively charged and there may not come any havoc by flooding in future.

Albedo :-

The albedo has not yet been studied for the city of jaipur, but it needs to be incorporated in the process of urban planning.

3.6 Transportation:-

Automobile Air Pollution is predominant in major urban areas and is estimated to account for 50% of the total air pollutional load. There were 11.14 lac vehicles in the year 1991-92 in the State of Rajasthan which is an increase of 26.84% and 11.72% over the number of vehicles in 1989-90 and 1990-91 respectively. Jaipur alone accounts for around 25% of the vehicles of the State.

As per rapid assessment the total pollutional load in the State on account of vehicular emissions may be around 1200 tonnes per day (TPD) of which jaipur alone accounts for 300 TPD.

In the context of Rajasthan, there is an increase of more than 1.00 lac vehicles per year. It has been reported that in the year 91-92, total number of vehicles in Jaipur was of the order of 2.8 lacs which was 12.86 and 24.32% increase over the years 91-91 and 89-90 respectively.

Having considered the significance of air pollution being caused by vehicular emissions, the Government of India has prescribed the standards of emissions for diesel as well as petrol-driven vehicles.

The exhaust emission standards are given here under :-

Petrol	Parameter	Limits
Two stroke Engine (idling)	CO	4.5% (by volume)
Four Stroke Engine (idling)	CO	4.5% (by volume)

Diesel		
Vehicles on full load	HSU*	75
Vehicles on free acceleration	HSU*	75
* Hartridge Smoke Units		

These vehicles emit carbon monoxide, hydro-carbons, sulphur-dioxide, oxides of nitrogen and black soot etc. into the atmosphere, resulting into gradual deteriorating quality of ambient air in the city of Jaipur.

As far as automobile emission control is concerned, the reduction of carbonmonoxide, hydro-carbon and oxides of nitrogen is generally achieved by air fuel mixture, combustion control, exhaust gas treatment and fuel modification.

Carrying capacity of Roads :

City roads of Jaipur can easily witness an average vehicular speed in the range of 5 to 15 kms. per hour which is significantly low and irregular resulting into higher vehicular emissions.

There is hardly any city road where the reasonable speed of 40 to 60 kms. per hour is being maintained.

Emergence of vehicular growth :-

Air pollution load in Jaipur on account of automobile emissions is reported to be of the order of 300 tonnes/day. The increasing growth of vehicles have been indicated in annexure 20 to 23 on time variable trends.

Traffic pattern :-

Jaipur city witnesses a mixed traffic pattern which allows different types of vehicles to ply on roads along with the Tonga, Rickshaw, Hand-Driven carts and bullock carts etc. This reduces the free flow of the traffic resulting into higher degree of air pollution.

Regular emission checks :-

The present practice in the city of Jaipur is that private petrol pump owners have been authorised by the State Transport Department for carrying such checks.

Traffic not destined to Jaipur should not be forced to pass through it and diverted through outer by passes. A network of regional roads should be developed/upgraded to meet the future transportation requirements. City roads and junctions should also be suitably developed.

Trade and commerce is being conducted from inside the densely populated walled city. The goods are first transported into the walled city which aggravates traffic problems in the congested walled city. Wholesale trade should be relocated outside the walled city in order to decongest the same. Similarly organised parking areas should be created inside the wall city. Arboriculture and landscape is proposed to be given special importance for development along the major roads. Implementation of a mass transportation system is a must for survival of the city.

Water Supply:-

Water supply for Jaipur city is catered by under ground sources as well as surface source. Public Health Engineering Department (PHED) is the main body responsible for supply of water in the states. But the many other areas and rural areas are dependent upon the tube well open well and hand pump. Ramgarh resource meets only about 30% of the total requirement and the rest is fulfilled by the tube well and hand pumps.

Existing water supply and distributors system.

1. Catchment Area of Ramgarh Reservoir 760 Sq. Km.
2. Capacity of Area Ramgarh Reservoir 111.73 M.cum.
3.Present water supply from Ramgarh lake 30 MLD.
4. Quantity of water supplied in walled city Area 70.00 MLD
5. Quantity of water supplied in outer zones 155.00 MLD
6. (i) Supply in walled city - Once a day.
   (ii) Supply in outer colonies - Daily for 2 hours in morning
   1-1 ½ hours in evening.

7. Water Table: Up to 40 m. with seasonal variation of 3 m water. Table is depleting at about 1 M every year.

About 78% tube wells in Jaipur water supply have more nitrate content than permissible limit of 45mg/litre.

Growing population and rapidly diversifying and expanding needs make water an increasingly scarce resource. Conservation of water and its best possible use are crucially important. Water is a natural resource which is renewable but not replaceable one - There can not be any substitute. In conditions of such scarcity it can well be said that water saved is water generated. The State Pollution Board has set up water quality monitoring station at various places in the State to assess the quality of surface as well as ground water. In Jaipur a monitoring station has been established at Ramgarh lake, Jaipur. The frequency of monitoring has been kept either monthly or quarterly. BOD, COD, DO (Dissolved oxygen), Total Dissolved Solid (TDS), Phosphates, Ammonical Nitrogen, Hardners chloride, fluoride, sulphate and pH are being monitored. The Central Pollution Control Board has laid quality standards with respect to their legitimate uses. These standards are categorised under Class A to E. The details lkof which are gin as under -

Class A.- Drinking water (Inland surface) witout conventional treatment but after disinfection - Quality of inland surface water under this category shall be such that it will be fit for human consumption without any treatment except disinfection by appropriate methods.

Class B.- This water is useful for bathing. The waters under proper sanitary supervision are considered safe and satisfactory for bathing purposes.

Class C.- Drinking water source with conventional treatment followed by disinfection. This is a source of water supply for drinking, culinary and food processing purposes after it is subjected to approved treatment such as coagulation, sedimentation, filtration and disinfection with additional treatment, if necessary to remove naturally present impurities.

Class D.- This water is fit for fish culture and wild life propagation.

Class E.- This water is used for irrigation, industrial cooling or controlled water disposal.

Permissible Norms.

Parameters	Class A	Class B	Class C	Class D	Class E
DS	500	-	2100	-	2100
O (mg/l)	6	5	4	4	-
OD(mg/l)	2	3	-	-	-
OD(mg/l)	-	-	-	-	-

Data relating to DO, BOD, COD and time variable trends have been developed over a period of time. Similarly, the trends with respect to TDS have also been developed at the monitoring station at Ramgarh lake., trends of DO, BOD and COD are almost static during different months of the year. The observed value of DO, BOD and COD indicate that in certain months they are beyond the permissible norms of drinking water without conventional treatment (Class A). The DO levels during certain months and years indicate below permissible norms even for Class C category. The BOD level has been observed as high as + 6mg/l in August, 1993 which is much beyond the permissible levels of 2 & 3 mg/l prescribed for Class A and Class C categories respectively. Trends in respect of TDS indicate the downward trend from the year 1991 to 1995 with a fall of around 400mg/l which is an interesting feature of improvement in water quality with respect to TDS mainly due to good rainfalls and rising water levels.

The availability of water from ground water resources may not be able to meet with the demands of the growing city. Initially it is proposed to supply water from reservoir after constructing a dam across Banas river of Tonk district. In the next phase the water will be required to be drawn from Chambal river. Interim arrangements of augmentation of supply from existing sources at Ramgarh reservoir and tube wells with additions and replacements. The other important aspect is to link all the zones with each other through proper design of feeder network for ensuring transfer of supply from surplus to deficit zones in order to achieve equitable distribution of water at city level. Strong measures are required to be taken to conserve the water to harvest rain water and to collect storm water for fulfilment of localised requirements other than drinking purposes.

3.8 Sewerage & Drainage:-

In the city of Jaipur, approximately 1.8 lac m3/day of sewage is generated which after treatment can irrigate around 1,800 hectares of land. It has also been reported that Methane gas can be generated which can be used as a fuel.The major objective of public waste water collection and disposal system is to ensure that sewage discharged from communities is properly collected transported, treated to the required degree and finally disposed off without causing any health or environmental problems. Rate of sewage flow depends upon rate of water supply to the community and the rate of ground water infiltration. It is observed that in the dry weather sewage flow is less than the per capita water consumption since some water is lost in evaporation, seepage into ground, leakage etc. For some areas, it is safe to assume the future density of population for designing purpose to be equal to the saturation density. There are two types of sewerage system Viz.

(i) Separate system :- Where one is designed to cater to municipal waste water and second to take care of storm water flows.

(ii) Combined system where both municipal sawage as well as storm water are carried in one network.

(iii) In case of Jaipur the sewerage system is abailable in walled city and housing colnies developed by housing boards and some J.D.A colonies. Over 400 approved husing cooperatives colonies, about 175 kachi basti, old clolnies in the city do not have provision of sewerage, only about one third of the total population is catered by the existing sewerage. A very large percentage of population still use open field for defecation.

The main object of sewage treatment is to stablize decomposable organic matter present in sewage and produce an effluent which can be disposed off in the environment without causing health hazards or nuisance. It is the subject of major concern for the environmentally safe development of the city. An improper case in this aspect creates breeding grounds for the mosquitoes resulting in various types of epidemic diseases. The various methods (viz; Primary, Secondary, Testing and biological methods) are available for the treating the sewage.In context of Jaipur city it is divided in two drainage zones namely. North zone and south zone. North Zone : The northern portion of city has a general slope towards Jal Mahal. The present population of north zone is about 3.33 lac. The discharge of north zone is being treated at the existing sewage treatment plant on Amber Road near Jal Mahal. The treated effluent is discharged into Jalmahal lake.

South Zone : The southern portion of city slopes toward Sanganer. The south zone has partial sewerage system and the sewage from sewer lines in being discharged into open filed near sodala. Same of the sewer water is used for cultivation balance quantity goes into Amanishah Nallah.

The P.H.E.D. has prepared a comprehensive sewerage scheme for north and south zones of Jaipur city amounting to Rs. 62.01 cores for designed population of 34.23 lacs in the year 2011.

Surface drainage for Jaipur is being implemented presently by multiple agencies. However all major nallaha (drains) around Jaipur are in irregular shape. This has prompted people to settle doing these nallas in an irregular manner and even water ways have been encroached. The developed area of city also faces acute problem of blocking of roads due to stagnant water during rainy season. It is proposed that an expert agency should investigate, plan design, implement and maintain the total drainage system for Jaipur City so that natural drains and reclaimed lands along drains become green areas of attraction instead of backyard as they presently are.

Solid Waste Management:-
Jaipur city generates around 1500-1800 tonnes per day of solid waste which according to studies can produce 35-40 MW of power. This power can be gainfully utilised for the city of Jaipur. Alternatively the compost can be manufactured and utilised.

For an efficient management of solid waste covered dustbins of suficient sizes should be provided to cover the entire area. Separate boxes be provided for collection of hazardous waste, normal municipal waste and high carbon content wastes so that they are collected in separate zones for useful processing. Hazardous waste i.e. wastes and disposal from hospitals, industries, slaughter houses be not allowed to mix with other solid wastes. Carcass utilisation centres should be set up in all four directions so that solid wastes of the direction need not to be transported to another direction.

here is still a practice of reclaiming non-destructible components garbage for recycling. In fact recoverable garbage contributes to nployment and manufacture, due to intrinsic value of the junk. ie residual organic matter is easily bio-degradable provided it is llected and transported to treatment centres. Organic waste is nenable to both trenching and to mechanical composting. The ast economic use of garbage is land filling, which is resorted to by ost of the cities. This practice will have its own limitations beyond limit Innovative solutions will have to be resorted to for a stainable basis.

ir Pollution:-

rban air quality has generally deteriorated due to growing dustrialisation and rising number of motor vehicles especially of orly maintained vehicles that use leaded fuel. Air pollution can use respiratory illness and death, physical damage and loss of sion. The vehicles which use leaded fuel account for about 95% air borne lead pollution (World Resources 1996-97) which may sult in loss of IQ and increased crime levels.

r pollution can also cause acid rains. Rain water analysis of urban vironment has indicated that pH of the first rain after summer was ways lower that the subsequent rains.

ealing with urban air pollution required a multi pronged approach. llution by stationary and point sources, factories is perhaps the siest to tackle. Standards of emission can be improved on them or ey may be asked to purchase from the competitive market quota emission. Severe penalties can be imposed if they exceed these. ducing emissions by vehicles is much more complex. First they ist identify quantitatively the most important vehicles. Thus for 'M emissions, two and three wheelers and trucks are more portant than cars whereas for lead emissions cars may be more portant. The approach should consist of the following elements -

Strengthening and introduction of mass transit system as ere use significantly less fuel per person kilo meter.

Better urban design to avoid congestion and reduce transport eds.

Better and efficient traffic control plan

Increase energy efficiency of vehicles. Thus four stroke engines for two and three wheelers can be very effective. Better maintenance can also help reduce emissions.

Air pollution in urban areas depends upon the particular type of source, its location and the climate. The concentration of air pollution in ambient air depend not only on the quantities that are emitted but also on the ability of the atmosphere to either absorb or disperse excess amount. The areas situated near lakes or surrounded by mountains or situated in a flat terrain influence the dispersion ability of the air pollution and may cause distinct pollution patterns to occur.

Rajasthan State Pollution Control Board has designed air monitoring project to assess ambient air quality at selected places to observe time variable trends. Monitoring stations were established in industrial, commercial and residential areas of Jaipur City. The pollution trends will help in understanding and planning air pollution control and management strategies.

The Air monitoring stations have been set up in Jaipur at following locations to represent industrial, commercial land residential areas:

V.K.I.A:- to represent industrial area.
AJMERI GATE:- to represent commercial and residential areas.
RPCB Office:- at Jhalana Institutional area - to represent Institutional cum-residential area.

DATA PRESENTATION:- An effort has been made to develop time variable trends of monthly average between June to December, 1995 with respect to SPM, SO_2 and NO_x for different areas as stated above. The observations have also been presented with the help of area graph bar diagram to give an insight into the emerging scenario.

ANALYSIS OF OBSERVED AIR QUALITY DATA:-

Suspended particulate matters (SPM):- It would be apparent from Annexure 18 which indicates the trends of monthly average of SPM levels at locations mentioned above that there is an upward trend of SPM, at Ajmeri Gate in as much as that there is an increase of around 120 ug/m3 of SPM concentration during a span of 6 months starting from July to December, 1995. The trends of SPM at Vishwa Karma Industrial Area and Jhalana Doongri tend to indicate almost the static pattern.

It would also be apparent from the aforesaid figures that the levels of SPM at Jhalana Doongri and V.K.I.A. are well within the permissible norms of 200 ug/m3 and 500 ug/m3 respectively. However, the levels at Ajmeri Gate are beyond the permissible norms of 200 ug/m3 and the upward trend indicates the higher levels in times to come.

The area graph presentation has been shown in Annexure 16 which tends to indicate comparatively non-fluctuating levels of SPM at various locations during different months of 1995.

The monthly average levels of SPM has been shown with the help of bar diagram in Annexure 16 which indicates maximum monthly average concentration (around 380 ug/m3) at Ajmeri Gate in the month of October, 1995 followed by observations recorded in the month of November, 1995. It also clearly indicates that the levels of SPM at Ajmeri Gate are exceeding the permissible norms (200ug/m3).

SULPHUR-DI-OXIDES:-

It would be apparent that the trends of SO2 levels on monthly average basis that there is a marginal decrease in the levels of SO2 at Ajmeri Gate and V.K.I.A., whereas the trend is almost static at Jhalana Doongri. It may, however, be noted that since the trend has been developed with the help of only 6 months data, it may not be representative on a time scale.

However, more data is required for developing realistic trend to come to a reasonable conclusion.

Area graph presentation has been shown in Annexure 17 which particularly tends to indicate non-fluctuating levels of SO^2 on monthly average basis.

11 NOISE POLLUTION:-

Noise the unwanted sound has been identified as a health hazard besides causing interference in communication. Noise is characterised by intensity and frequency. Sound as such measured in terms of its loudness, in decibels. Decibles scale lis logaritumic corresponding to the response of the human ear to the intensity variation of sound. Thus log of the ratio of sound intensity to a reference intensity is decibel. In order to gäuze the ambient noise levels in Jaipur City monitoring sites were selected in the four standard types of zones i.e. Residential, commercial, Industrial and the sensitive or silence zone in November, 1995.

The sound level meter type CRL 2.37B was used for measuring noise levels in decibles. The microphone fitted with wind screen was kept at a height of 1.5 meters above the ground at all the monitoring sites. This height is the average taken for a position of human ears. Monitoring of the noise was done for a period of 10 minutes at different times of the day at each of the sites, for an aggregate period ranging from one to two days. Within the monitoring time period of 10 minutes, measurements were recorded at internals of 10 seconds, totalling to 60 readings for each monitoring period. For the purpose of analysis, they have been further split into day time and high time recordings, the day being treated from 6AM to 9PM as per prescribed standards -

For each set of 60 readings over a period of 10 minutes, the leq value was calculated and then averaged on the whole as well as for day and night times separately for the various area types.

10 or ten percentile Exceeding level is the level of sound which is exceeded 10% of the total time of measurement. In instant case the time of measurement was 10 minutes and the readings were recorded at intervels of 10 seconds. Hence L10 is the level which was exceeded for 1 minutes in a total of 10 minutes. Similarly the L30, L50, L70 and the L90 values.

Noise pollution:-
Assessment of Noise level in Jaipur is a well recognised fact that the pollution created by noise is confined to Urban areas, near airports, industrial estates, construction activities etc.

In case the Urban planning in scientifically done with necessary

inputs of environmental components, the noise pollution levels should have been within the permissible norms. These permissible norms as prescribed by the central pollution control board for different areas are being reproduce here under:

Area Code	Category of Area	Limits in decible db (a)	
		Day time	Night time
A	Industrial area	75	70
B	Commercial Area	65	55
C	Residential Area	55	40
D	Silence Zone	50	40

AMBIENT NOISE LEVELS IN JAIPUR

In Jaipur the monitoring of ambient noise levels was carried out in the month of November, 1995 at various locations of all the area types. Table below shows the ambient noise levels (avg.Leq) for the different Zones and their variation from the standard. Only the night-time avg. Leq for industrial areas is below standard, rest all exceed them.

AMBIENT NOISE LEVELS AND PERCENTILES FOR VARIOUS AREA TYPES JAIPUR

Similarly Table below shows the percentile values for the four zones and histograms for the same follow, separately for day and night times. As indicated in Annexure-12.

AMBIENT NOISE LEVELS FOR VARIOUS AREA TYPES JAIPUR

AREA TYPES	NOISE LEVELS Leq		VARIATION FROM STANDATD	
	DAY	NIGHT	DAY	NIGHT
RESIDENTAL	75	67	+20	+22
COMMERCIAL	78	76	+13	+21
INDUSTRIAL	78	66	+3	-4
SENSITIVE	77	67	+27	+27

A. RESIDENTAL

The avg. Leq level for residential areas during day-time was 75 dB whereas for night-time it was 67 dB. The peak noise level or the ten percentile value L10 was 79 dB for day-time and 70 dB for the night-time.

A histogram showing the ambient noise levels at various residential locations in Jaipur during day and night times has been shown in annexure 14 & Table 1

(Table - 1)

S.No.	Location	Noise Level (Leq)	
		Day	Night
1.	C Scheme Mahaveer Marg	72	65
2.	Gandhi Club	75	58
3.	Jawahar Nagar	81	78
4.	Malviya Nagar	73	68

B. COMMERCIAL

For the commerical areas of Jaipur the avg.Leq during day-time was 78 db and was 76 dB during night-time. The L 10 value for day-time was 81 dB and for night-time it was 79 dB. They clearly exceed the standards. A histogram has been shown in annexure 14& Table 2 for the various commercial sites.

(Table - 2)

S.No.	Location	noise Level (Leq)	
		Day	Night
1.	Ajmeri Gate	82	78
2.	Badi Chopar	81	80

3.	Chandpole Bazar	84	78
4.	Jhalana Opp. RPCB	67	51
5.	Raja Park Near H.Dhaba	70	67
6.	Transport Nagar	87	88

C. INDUSTRIAL

The ambient noise levels or the avg. Leq values for the industri zone were 78 dB during day-time and 66 dB during the night-tim marginally exceeding the standard during day-time whereas belo the same during night-time.

The histogram as indicated in annexure 13 & Table 3 shows th levels at different industrial locations during day and night time.

The L10 values for the industrial areas came out to be 81 dB and 6 dB for day and night times respectively.

(Table - 3)

S.No.	Location	Noise Level (Leq)	
		Day	Night
1.	Industrial Area Sanganer	82	78
2.	Malviya Nagar	81	80
3.	V.K.I.A.	84	78

D. SILENCE or SENSITIVE

The avg. Leq levels for the silence zones were 77 dB during day time and 67 dB during night-time, both exceeding the limit equally. The peak or L 10 levels were recorded as 80 and 71 dB fo day and night times respectively.

Conclusion : In view of such high noise levels even in sensitiv areas in an alrming situation for which effective environment consideration in the development of Urban planning needs to b considered. It is therefore strongly recommended that sufficien green belt should be provided all along the roads and the ope spaces, parks. play grounds and open areas may be provided wit extensive tree plantation so that areas may act as buffer zone for th reduction of ambient noise level which are at present exceedin

3.13 Urban Land use pattern:-

Jaipur city has mixed type of land use distribution without following planning norms and standards mainly due to conventional nature of planning. Consequently, the present scenario of physical development has invariably the dent of hundreds of kutchi bastes and unauthorised colonies constraining the planned development of the city. The mixed landause has mainly been developed along the radial road corridors of the city. Several buildings have been commercialised in walled city.

The land use distribution of the city indicates that the total developed area has increased 3 times from 1971 to 1991 whereas the land use share in respect of recreational and tourist facilities has comparatively gone down. This indicates the fact that the land use development has been made in respect of residential, commercial, industrial and other uses of land ignoring the environmental supporting features like recreational and tourist facilities from 1971 to 1991.

Jaipur is known to be a tourist place which has a strong economic base for the city - thus requiring important input towards recreation including development of parks, tourist facilities and keeping open spaces to the extent that it imparts cooling and clearing effect and aesthetic component to the city of Jaipur.

In the city of Jaipur, concreting of surface area is increasing with the expansion of the city but optimization of concreting and non-concreting surface area needs to be regulated through the process of urban planning during expansion of the city.

Optimization of Vertical to horizontal expansion of the city needs effective regulation in the city of Jaipur in times to come.

Zoning of Land use activities.- For the city of Jaipur, land use pattern is indicated in Fig.1 and some of the salient features are indicated below :

			(Actual dlvelopment 199 as compared to Proposal of 1991 Master Plan)	
Sl. No.	Land use	Total Development	Area in acres developed in right places	Develop in wrong places
1.	Residential	15880	12014	3866
2.	Commercial	950	684	266
3.	Industrial	2490	1767	723
4.	Governmental	390	287	103
5.	Recreational	530	487	43
6.	P & S.P.	2120	1751	369
7.	Tourist Facility	-	-	
8.	Circulation	2910	2909	

Sources : Draft Master Plan 2011, JDA region.

The population will have to estimated with due regard to all t factors governing the future growth and development of industri commercial residential, educational, social and administrati spheres.

When we are estimating to predict the population growth, we shou give considerations to few points because these are causes change in population.

(i) by birth (population gain)
(ii) by death (population loss)
(iii) Migration (population loss & gain depending upon wheth movement out or in occurs).

Master plan with land use pattern and zoning regulations available for the town, the anticipated population can be based (the ultimate densities and permitted flow space index provided f in the master plan. In the absence of such information the followi densities can be used.

Size of Town (population)	Density of population per hectare
upto 5,000	75 - 150
5,000 to 20,000	150 - 250
20,000 to 50,000	150 - 300
50,000 to 1,00,000	300 - 350
above 1,00,000	350 -1,000

Source. CPHEEO 1993. (Ministry of Urban Development)

In cities where Floor space Index FSI or Floor Area Ratio FAR limits are fixed by the local authority this approach may be used. FSI pr FAR is the ratio of total floor area to the plot area.

In case of walled city area of Jaipur which does not have any scope for expansion has been projected by Arithmetic Increase method. Area outside the walled city have been projected by Growth factor method.

The projected population figures for Jaipur city are 19.34 lakh for 1996, 24.89 lakhs for 2001 for 3228 lakhs for 2006, 42.16 lakhs for 2011 and 55.40 lakh for 2016.

Year	Projected Population
1996	1934888
2001	2488956
2006	3228059
2011	4216318
2016	5540073

Source: Draft Master Plan 2011, JDA.

It is anticipated that the Jaipur city and its surrounding areas will predominantly continue to maintain its character as the centre for the trade and commerce, administrative city and an important tourist place. The growth for urban activities will generate additional demand on the agricultural produces from the rural areas and hinterland.

The urbanisable land contiguous to the present urbanized limit of Jaipur has an area of about 154 sq. km. Together with area of approximately 116 sq. km. under the present urbanized limit the total area works out to approximately 270 sq. km. After discounting unable agricultural land, areas from environmental considerations the holding capacity of this urban area of Jaipur city region works out to 35 lacs @ density of 13000 persons per sq. km. If the poulation as projected by statistical methods is allowed to concen trate in the Jaipur urban area without any intervention the result may be either very high densities or engulfment of highly fertile lands for urban areas. The resultant impact is environmental degradation and deterioration in quality of life.

The projected increase beyond 35 lacs, therefore, will have to be distributed and deflected to satellite towns and second order settlements by planned interventions. To ensure balanced development of the region development should be undertaken in a hierarchy of tiers such as Jaipur city urban complex, outer ring of satellite towns to accommodate all urban functions so as to attract migrant population, inner ring of satellite towns which are not engulfed in the contiguous area of Jaipur city urban complex and rural areas of the region. These rural settlements should be provided with basic infrastructure facilities in order to play an integrated and complementary role in the developments of the region. Although the incremental costs of accommodating additional population in an existing city is generally lower for small increments as compared to setting up a new town.. In the long run the congestion overtakes and overall costs become very high.The cost of expanding a city beyond a certain point is very high. A new town will be cost effective after the city attains a certain population level.

A via media has been attempted in several countries by developing satellite towns around large cities. But this concept cannot be cost effective and generally proves counter productive in achieving the laid down objectives. Several towns developed along the same corridor will be more cost effective than developing satellite towns in different directions. By this approach high density corridors along railways will be conducive for viability of high capacity ralway system. The availability of local water resources and other infrastructure network should be necessary attributes for potential of a corridor. Empasis on Tonk Road area and development of more and more townships along Tonk Road may be an admissible corridor development in case of Jaipur.

The preparation of a master plan with traditional land use planning approach offers little flexibility and would not adjust to the changing situation as may occur in future. As a result development takes place in wrong areas and large scale plan violation are noticed. The planning process should, therefore, incorporate land use trends of population growth, economic factors, housing requirements, social infrastructure such as education & health, physical infrastructure and environment, transportation, electricity and power, physiographic studies, micrometeorological parameters, air and water quality, drainage and sewerage, land classification so that planning plays an promotional role and acts as a catalyst to achieve the goal of comprehensive sustainable development. Timely action is the essence of any development and delays lead to obsolescence of plans even before they are prepared since growth of urban area does not mait for plan finalisation. Comprehensive redevelopment project are required to be undertaken for special areas where haphazard mixed use has been experienced. Walled city area which is of historical importance is required to be decongested. The project for redevelopment and conservation of wall city may include aspects related to conservation, tourism, decongestion, sewerage and drainage, environmental upgradation, traffic and transportation, urban design, architectural heritage, fairs and festivals etc. Haphazard ribbon developments along major traffic arteries requires curative and preventive measures. Further growth of ribbon development should not be allowed and sufficient safeguard to allow required parking and smooth traffic flow in the well city should be ensured. Industrial areas towardsthe North-West are on the wind-ward side of the city and in this respect location of these industries are faulty. It is proposed that utmost precaution of air polluting industries in these areas have to be taken as special areas for formulation of programmes and projects wherein relocation of polluting in distress may be considered with adequate rehabilitation measures. Bagru and Sanganer towns are traditional strongholds of cloth dying and printing industry operative in unorganised sector. Effluent treatment plants may be required near Sanganer and Bagru. Green belts should be developed around the proposed industrial estates to serve as a buffer zone which be taken up on priority alongwith the development of other infrastructure of the industrial estates. For existing industrial areas similar efforts be made to create green girdles to the extent possible. Location of industrial area and type of industries in the area should be sympathetic to the quality and quantity of environmental parameters and should take into account existing abadi areas. Rich agriculture land should be conserved to the exent possible and must be protected against indiscriminate urbanisation. Built environment, character of the city, conservation of urban heritage should be given due importance.

Amanishah Nala which passes through Jaipur city should be guarded against bank erosion. The nalla and abutting land should be utilised to develop a continuous belt of green area, punctuated by recreational zones after adequate treatment of nala cross section and reclamation and acquisition of land. Besides providing for a hierarchy of parks and green spaces in different planning zones regional level forests, wood lands and recreational areas should be proposed in the plan. Mining activities should be shifted from areas facing developed urban areas to other suitable locations. Appropriate rehabilitation measures should be considered while implementing such relocation.

4. RECOMMENDATIONS AND IMPLEMENTATION ISSUES

4.0 In view of the importance of environmental parameters the same should be incorporated in urban planning, negligence of any of these parameters may cause environmental misbalance which may be irreversible innature making urban development unsustainable.

4.1 Jaipur the Pink City has been a major tourist attraction and repository of architectural splendour. The city is facing continuous damage to its environment due to inadequate attention to disposal and management's of solid waste and sewage. The quality of drinking water has also deteriorated. Air pollution has increased the incidence of respiratory infections. The once beautiful Jal Mahal Lake has now become a sewage dumping site. The urban planning has to be done in a comprehensive manner incorporating environmental parameters and micro-meteorological parameters.

4.2 Noise pollution has crossed the permissible norms in the city of Jaipur in almost all the classified areas namely residential, commercial and even survitive locations. Noise lends in some of the industrial areas hence been found within the permissible norms mainly because of the excessive limits prescribed for these areas.

4.3 Industrial areas set up without consideration of such concepts and mind directions and frequencies must be made sympathetic to environmental condition by special projects and precautionary steps.

4.4 Air pollution has reached beyond the permissible in the city of Jaipur - particularly with respect to suspended particular matter (SPM) generated partly on account of excessive growth of vehicles and inadequate carrying capacities of roads. Immediate necessary steps may be taken to control traffic congestion and vehicular pollution.

4.5 Adequate infrastructure for sewerage and drainage, transportation and road network electricity and power, trade and commerce, tourism, administrative city's requirements, drinking water, industrial development may be developed in the comprehensive development plan of Jaipur region.

4.6 It has also been witnessed that the heat island phenomenon is in existence in the city of Jaipur possibly on account of excessive vehicular growth, increasing growth of concrete surface, increasing green house gases emissions due to combustion of fuel and so forth. The city in saucer shaped surrounded by hills on the western, eastern and north-eastern sides. There is increasing danger of Albedo effect, which arises due to large concrete surface area as compared to non-concrete areas. Addition of more and more concrete areas in the city is causing heat zones to be formed. Optimisatran of concreting to non-concreting surface areas holds the solution.

4.7 Application of micro-meteorological conditions has not been properly addressed cultivating into unplanned location of some industrial areas from environmental angle. The major industrial areas are located on the down wind side of the city carrying polluted air over the residential areas. Adeauate safeguards need be taken in this regard, Open spaces such as Ram Niwash Bagh and polo ground play on important positive role in controlling air pollution and maintaining micrometer-logical condition. These should be maintained and more such spaces should be provided wherever possible.

4.8 All concerned be strongly forewarned for a limited availability of water suitable for human consumption. Long term plans for water supply may be formulated and executed without delay.

4.9 In order to decongest the walled city the whole sale business activities be relocated in the areas designated as work centres in second order settlement and satellite towns. Work centres as identified be developed as urban nodes. Informal sectors be acknowledged as major activity and treated as priority area for integration in the main stream of land use. The function and activities which do not have day to day interaction with rest of the activities of Jaipur City should be relocated outside the main urban complex in the satellite towns or corridors. Uses hitherto considered to be urban functions and which have now outlined their locational relevance in the metropolitan context should be relocated in the outer areas.

4.10 Areas that have witnessed unplanned mixed use should have suitable redevelopment projects. Also haphazard ribbon development must be controlled with suitable remedial measures.

4.11 The effort of Tourism on eco-system must be studied in detail. Tourism should be correlated to the available resources and carrying capacities. The art and architecture must not be vandalised by the force of urbanisation. Their decay and extinction must be checked. Conservation of historical monuments and development of places of tourist interest and cultural significance bedeclared priority areas for development of facilities of national and international levels.

4.12 Development Regulation measures be taken for lands along the National highways and their Bye-passes upto a depth of 500 metres on both sides, permitting only such uses which do not affect the desired level of service of these routes, are not detrimental to the visual quality of the highways and are conducive to the environment.

4.13 Detailed micro plans for planning zones of Jaipur Development Authority region be prepared and development regulated to implement desirable features.

4.14 Provisions under various Rules and Regulations operative in the region that are derogatory to a planned development and effective management of the region be reviewed and suitably amended. Urban area is a function of its hinter land. Development of hinter land must be given due importance. Prime agricultural lands should be reserved for use as agricultural lands only. Rural centres be declared as action areas and be treated at par with urban area of the region for provision of services and facilities.

4.15 Development of Jaipur being extensive and horizontal in character an efficient mass public transportation be developed as early as possible.

4.16 IMPLEMENTATION ISSUES

It is often found that fragmentation of cognate responsibilities and distribution of their administrative charge among a number of authorities lead to disharmony in planning and implementation. When housing is given to one authority and water supply &

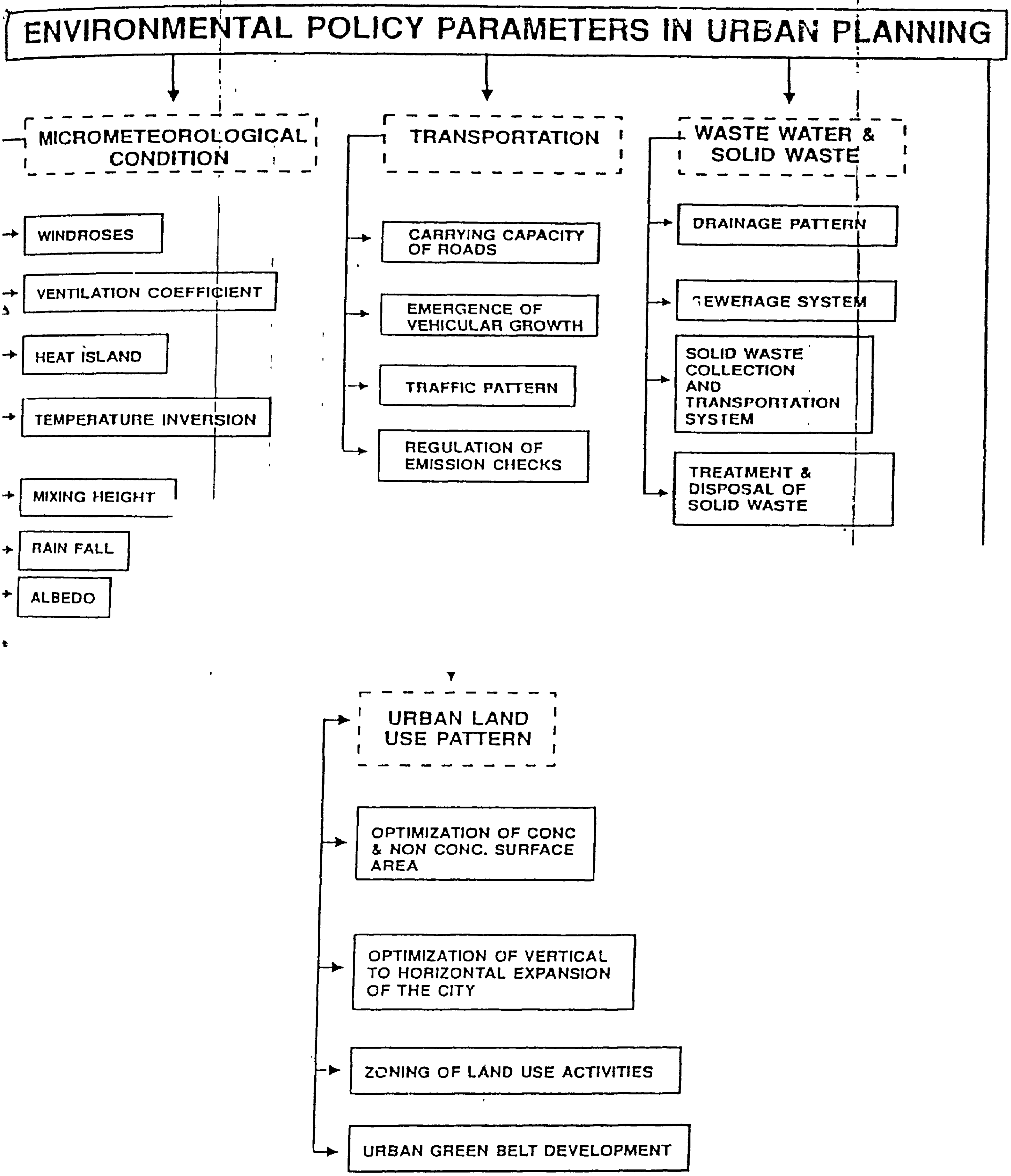
sewerage to another, the two sets of functions become difficult to synchronize. While the Jaipur Development Authority (JDA) operates in its scheme areas, municipal corporation is mainly engaged in works in the walled city. There are numerous other agencies who carry out development works in the areas under their jurisdiction. There are evidences of organisations working at cross purposes. To cite a few instances regulation of building constructions which is vital for guided urban development remains a bone of contention between the JDA and municipal corporation.

The JDA's jurisdiction does not cover all the peripheral rural-urban areas which are under the dual control of the District Administration and Panchayat Raj Authorities. Because of their urbanizability potential in the near future, those rural tracts need to be covered by planning mechanism to guard against haphazard urban growth which it will be very costly to rectify later on. Thus Jaipur today suffers from both geographical fragmentation and functional fragmentation.

The "Environment Services" including planning, housing, water supply sewerage, waste disposal, transportation & like have to be looked at as one group of closely interlinked function and these need to be administered from one centre. There are some other services which cater to purely local community needs as distinguished from total urban area needs. In this would fall local streets and lanes, local drainage, small local parks, Local public library, street lighting, vaccination & inoculation, birth & death registration etc.which can be entrusted to a number of lower locality level organizations. Thus present organisation needs to be changed to ensure intergrated long term urban development.

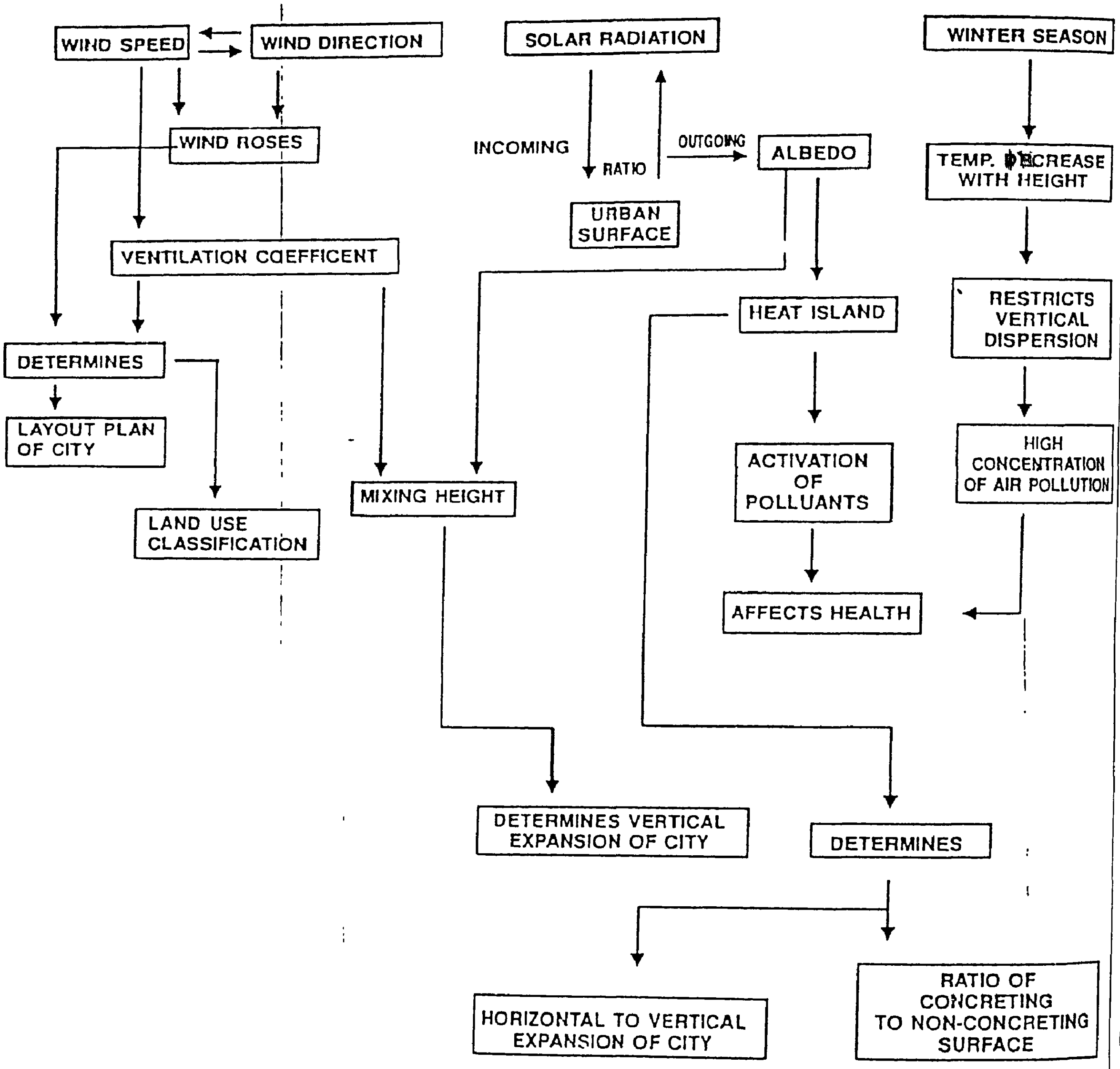
Availability and reliability of vast amount of data regarding environmental parameter especially relating to micrometerological parameter limits their application in urban planning. However available data do provide indicators as to better choices for urban planners for sustainable development.

Annexure 1


ENVIRONMENTAL POLICY PARAMETERS IN URBAN PLANNING
MICROMETEOROLOGICAL CONDITION
WINDROSES
VENTILATION COEFFICIENT
HEAT ISLAND
TEMPERATURE INVERSION
MIXING HEIGHT
RAIN FALL
ALBEDO
TRANSPORTATION
CARRYING CAPACITY OF ROADS
EMERGENCE OF VEHICULAR GROWTH
TRAFFIC PATTERN
REGULATION OF EMISSION CHECKS
WASTE WATER & SOLID WASTE
DRAINAGE PATTERN
SEWERAGE SYSTEM
SOLID WASTE COLLECTION AND TRANSPORTATION SYSTEM
TREATMENT & DISPOSAL OF SOLID WASTE
URBAN LAND USE PATTERN
OPTIMIZATION OF CONC & NON CONC. SURFACE AREA
OPTIMIZATION OF VERTICAL TO HORIZONTAL EXPANSION OF THE CITY
ZONING OF LAND USE ACTIVITIES
URBAN GREEN BELT DEVELOPMENT

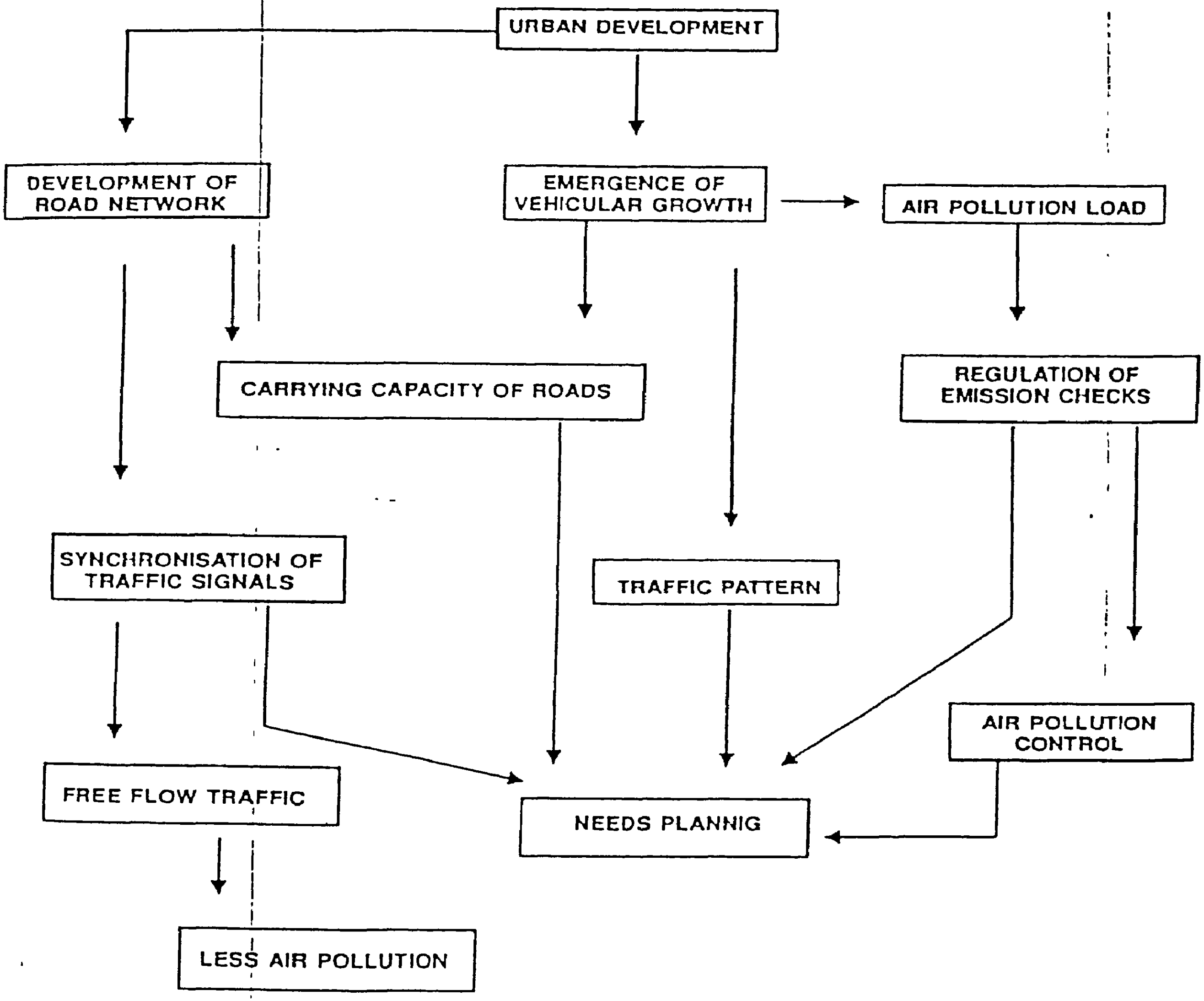
Annexure 2

MICROMETEOROLOGICAL CONDITIONS



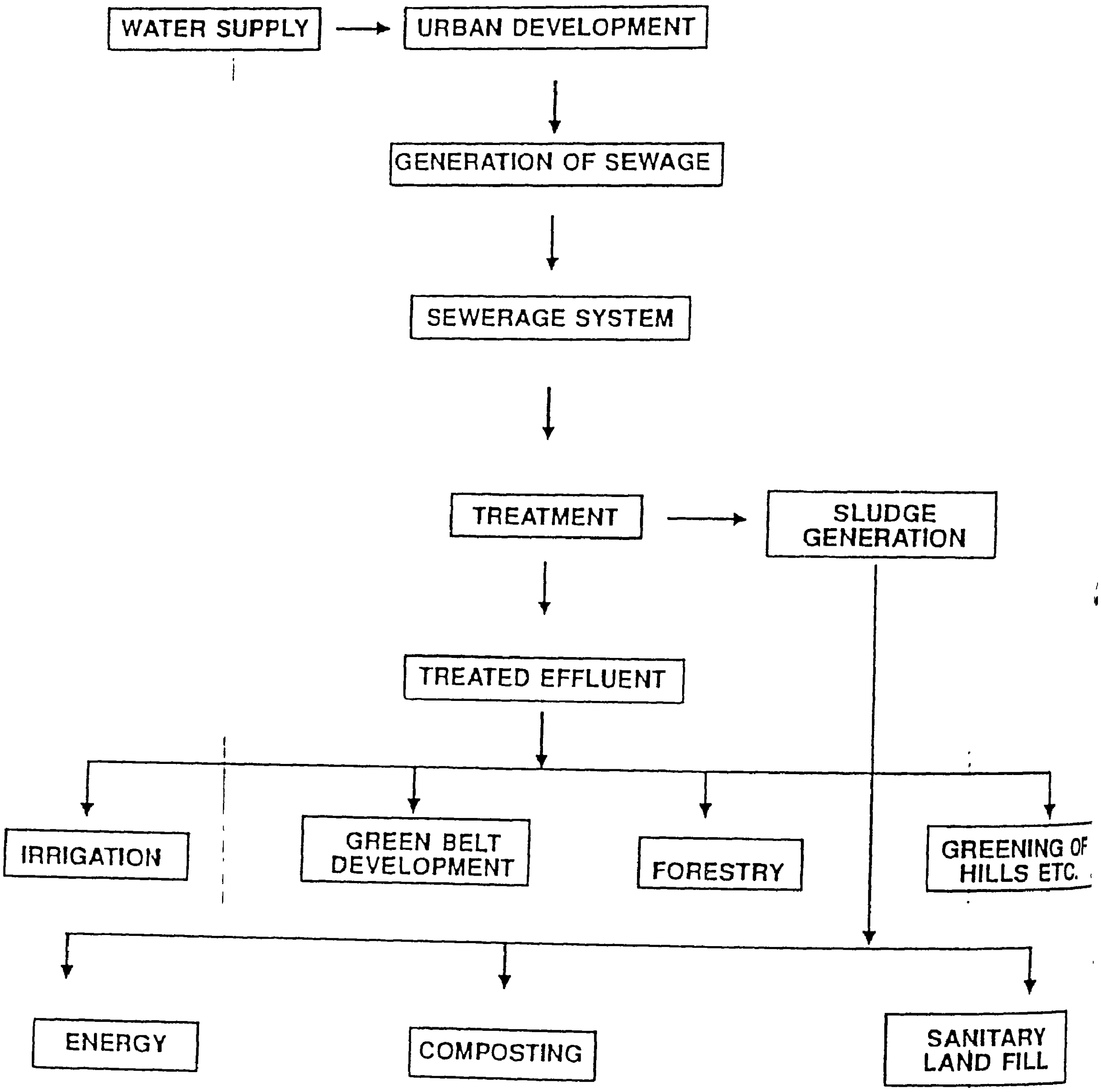
Annexure 3

TRANSPORTATION


URBAN DEVELOPMENT
DEVELOPMENT OF ROAD NETWORK
EMERGENCE OF VEHICULAR GROWTH
AIR POLLUTION LOAD
CARRYING CAPACITY OF ROADS
REGULATION OF EMISSION CHECKS
SYNCHRONISATION OF TRAFFIC SIGNALS
TRAFFIC PATTERN
AIR POLLUTION CONTROL
FREE FLOW TRAFFIC
NEEDS PLANNIG
LESS AIR POLLUTION

WASTE WATER AND SOLID WASTE

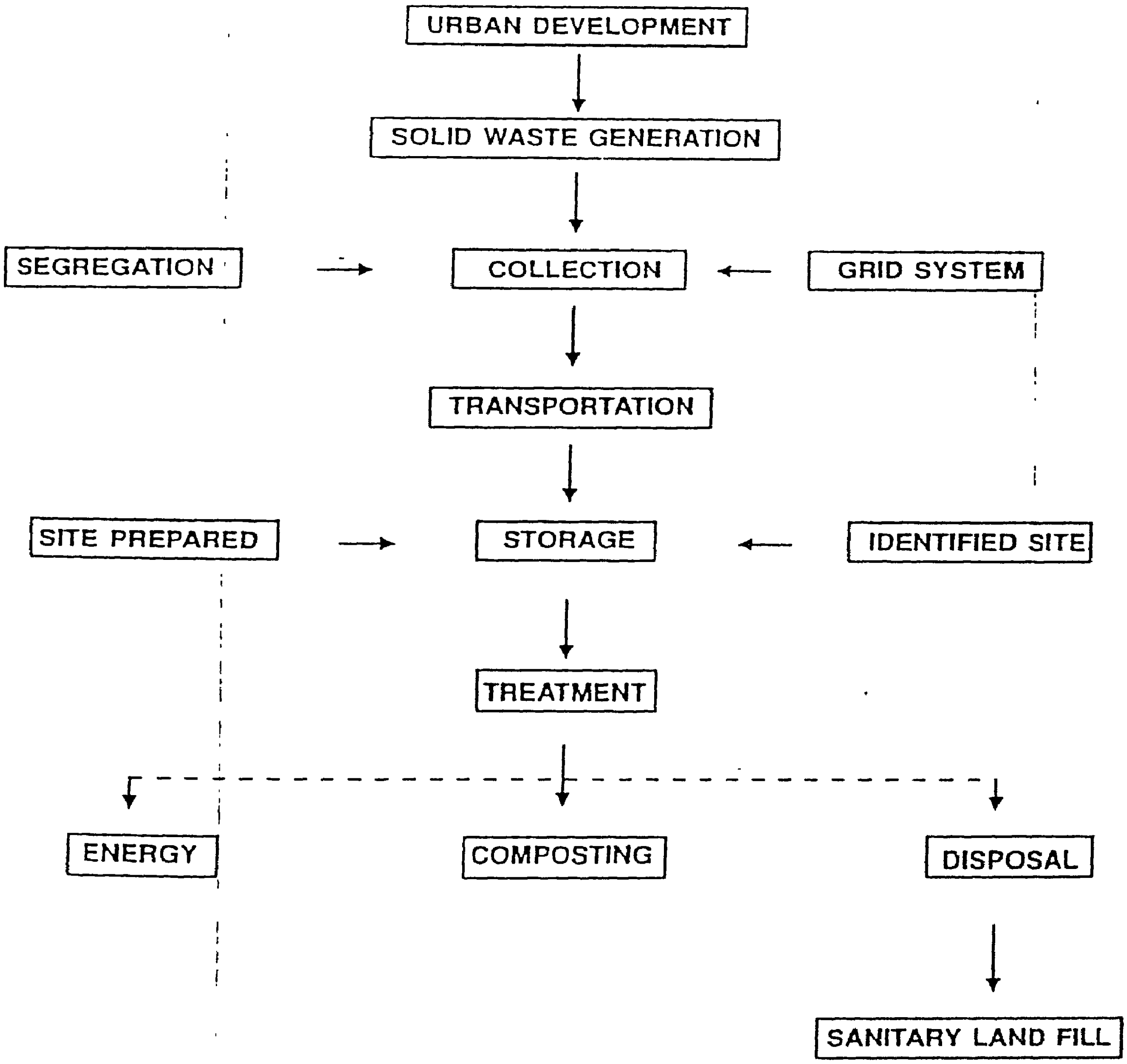
FUNCTIONAL ELEMENTS OF SEWAGE MANAGEMENT



Annexure - 5

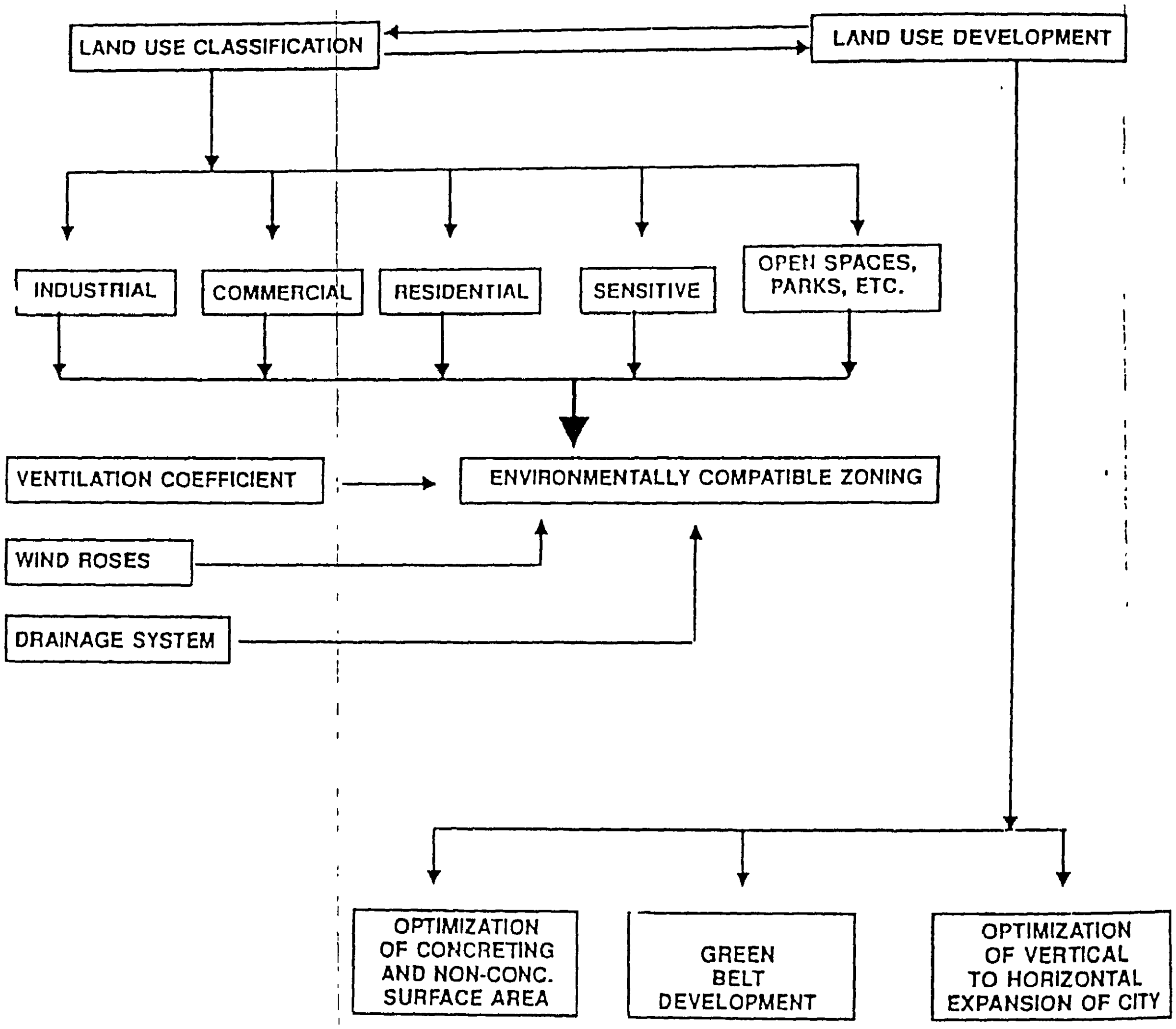
WASTE WATER AND SOLID WASTE

FUNCTIONAL ELEMENTS OF SOLID WASTE MANGEMENT SYSTEMS

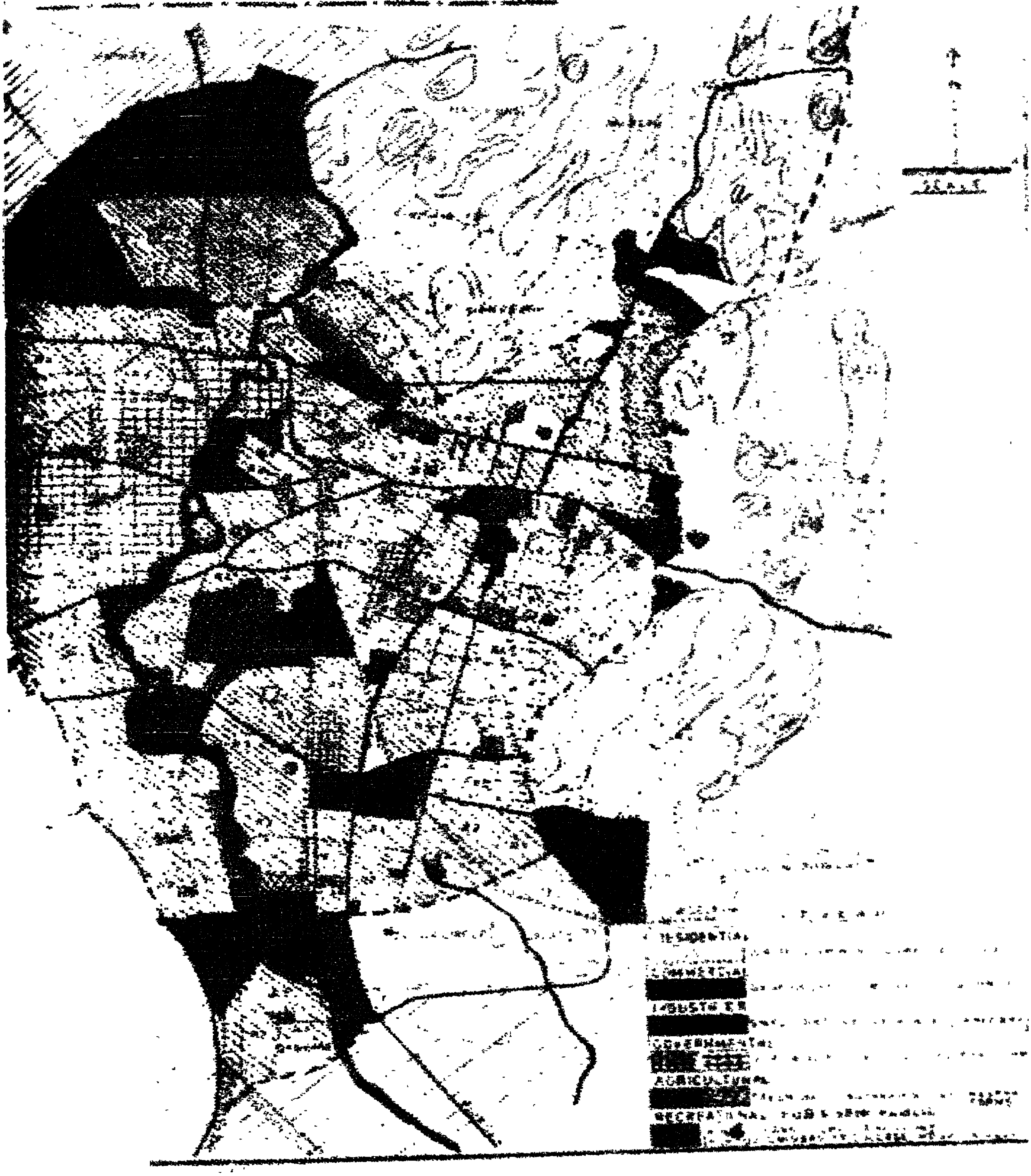


Annexure

URBAN LAND USE PATTERN

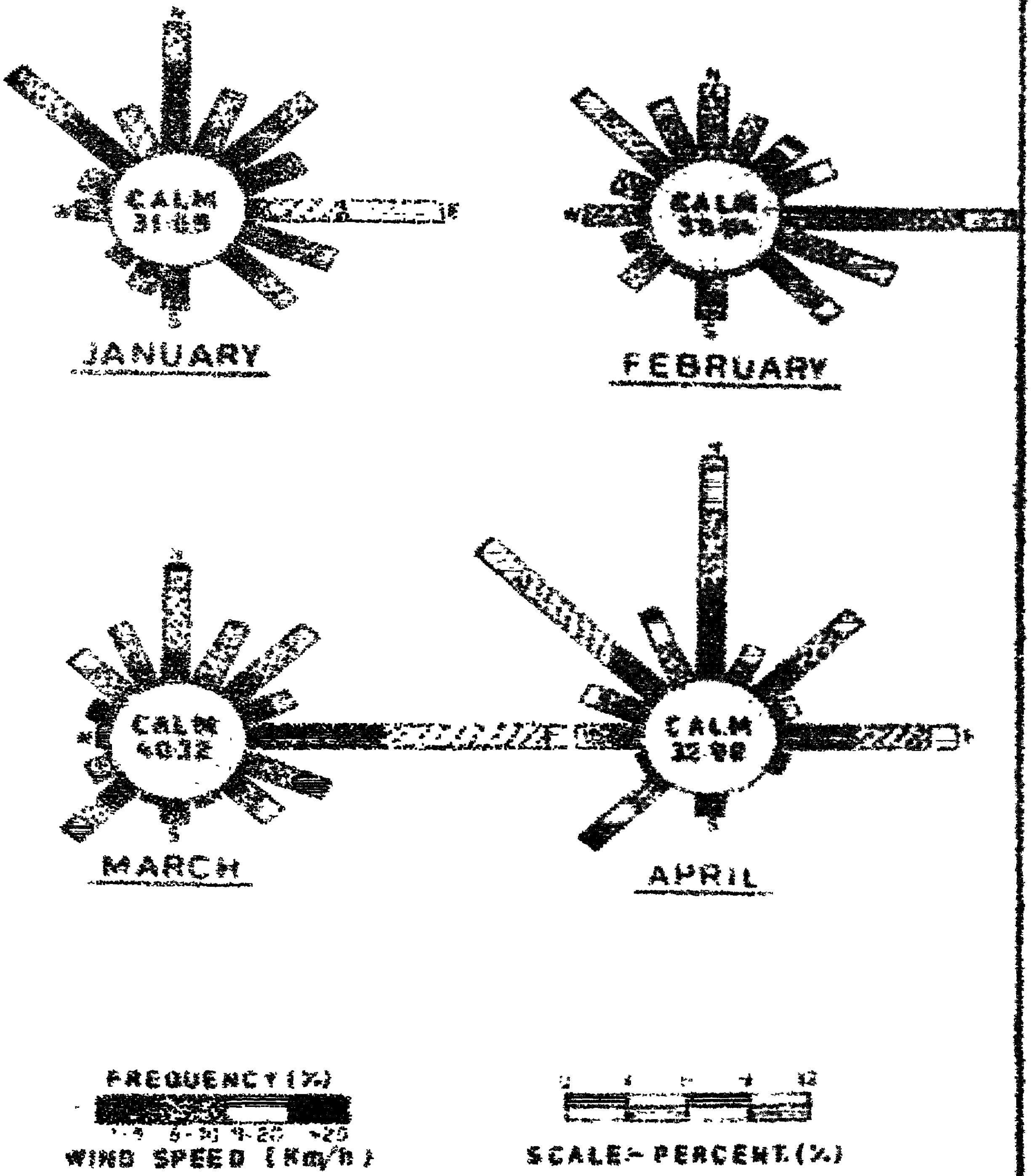


MAP OF LAND USE PLAN

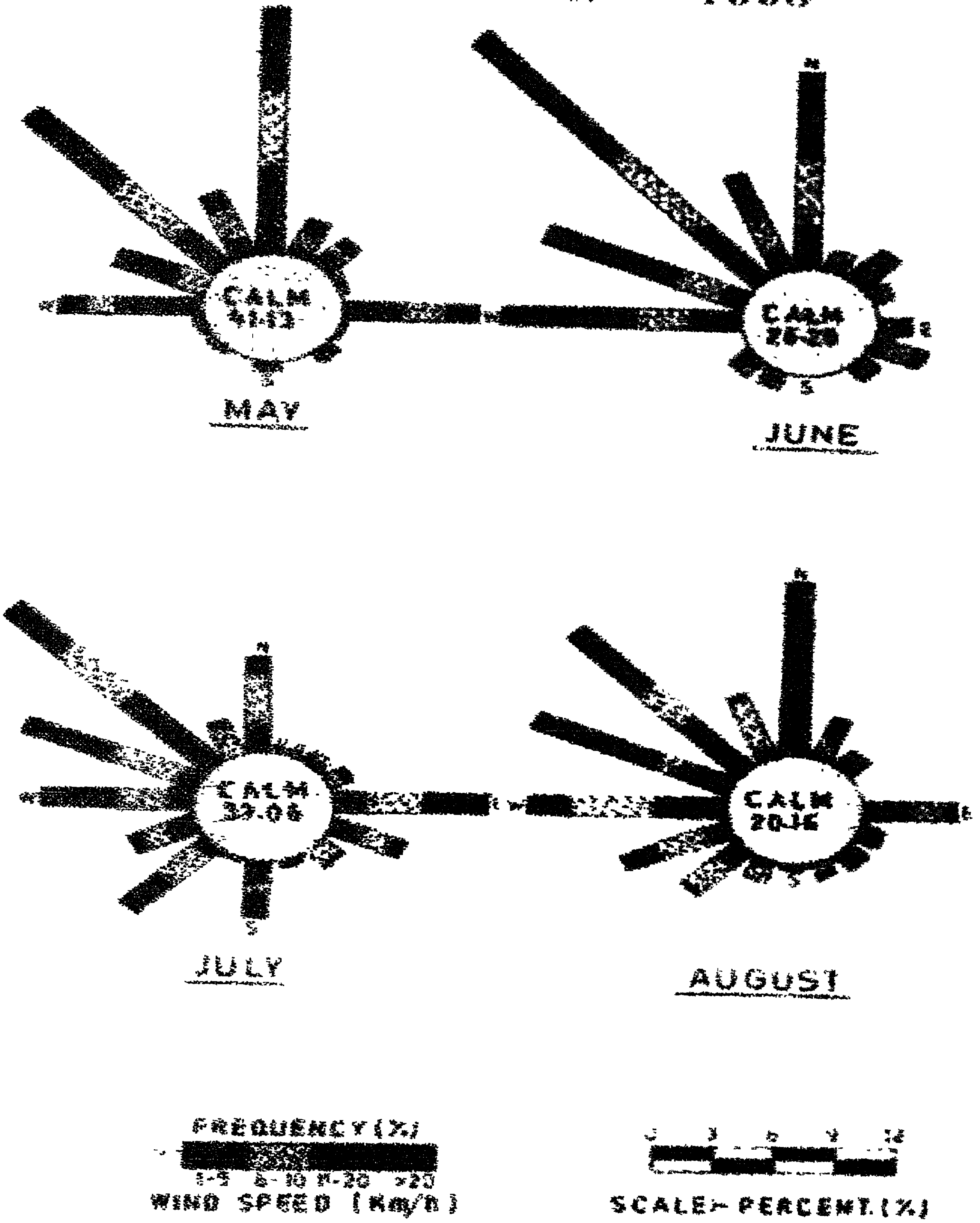


ANNEXURE - 9

MONTHLY WIND ROSES FOR JAIPUR - 1995

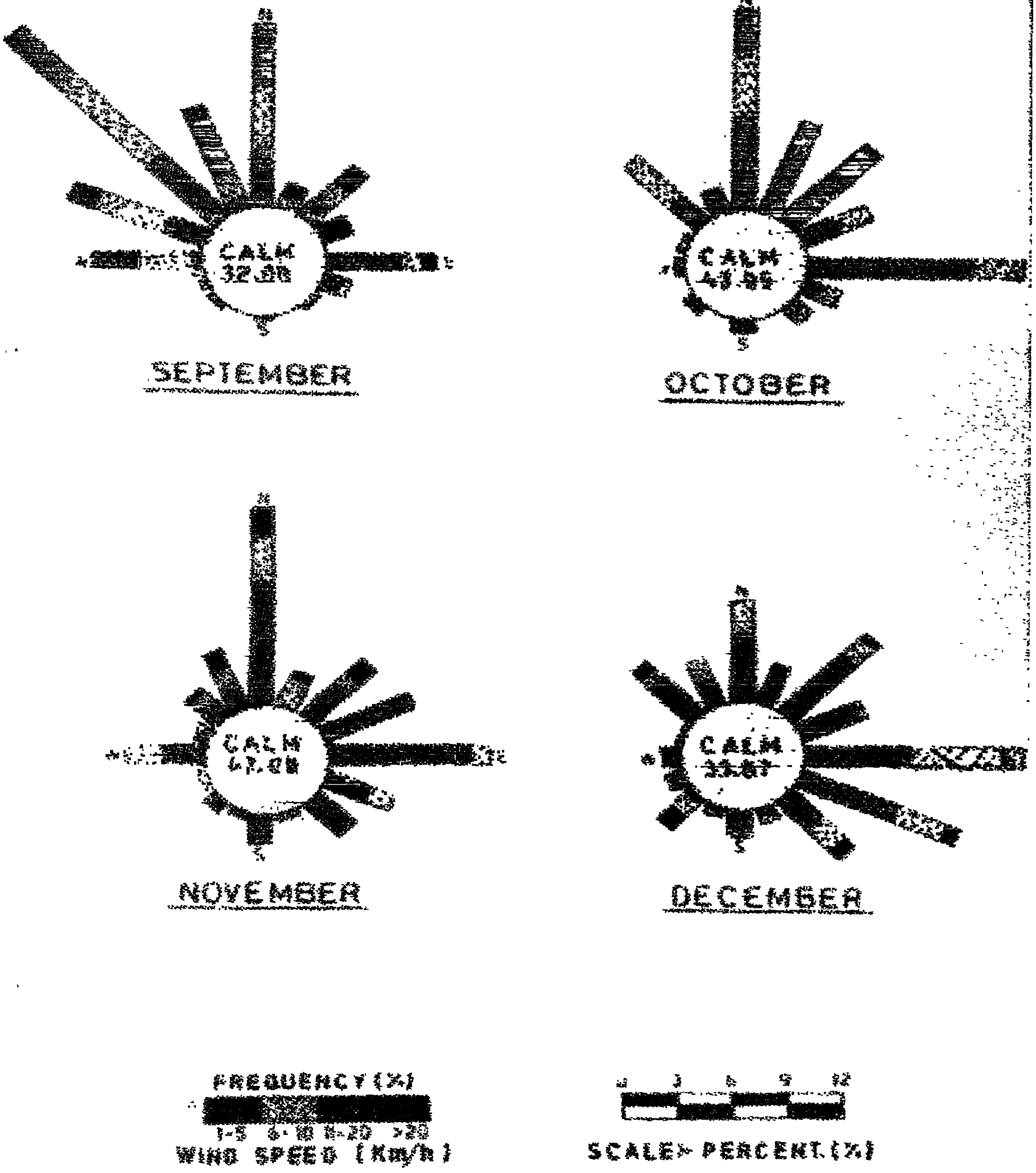


MONTHLY WIND ROSES FOR JAIPUR - 1995

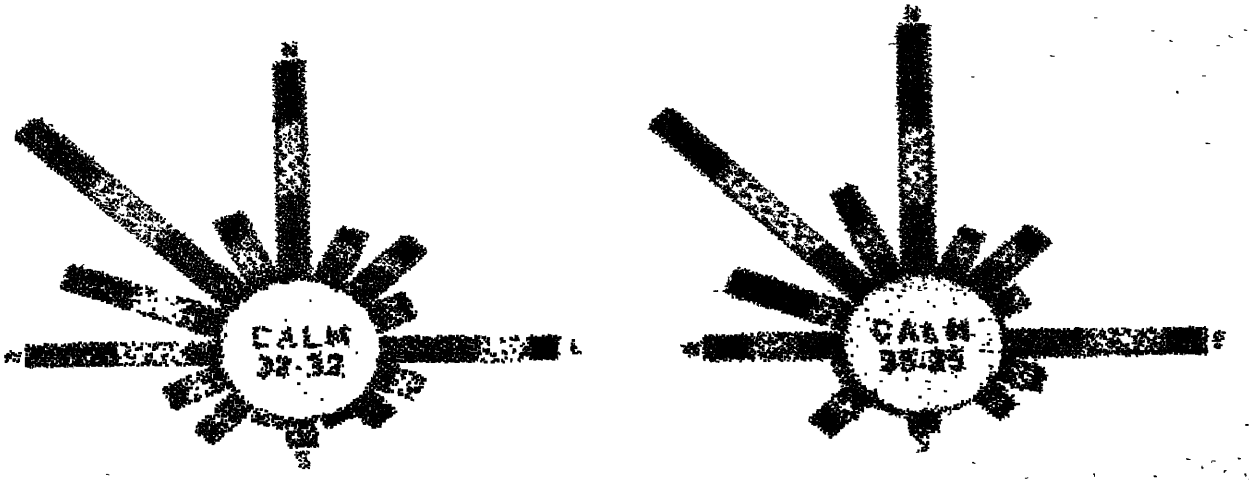


ANNEXURE - 10

MONTHLY WIND ROSES FOR JAIPUR - 1995

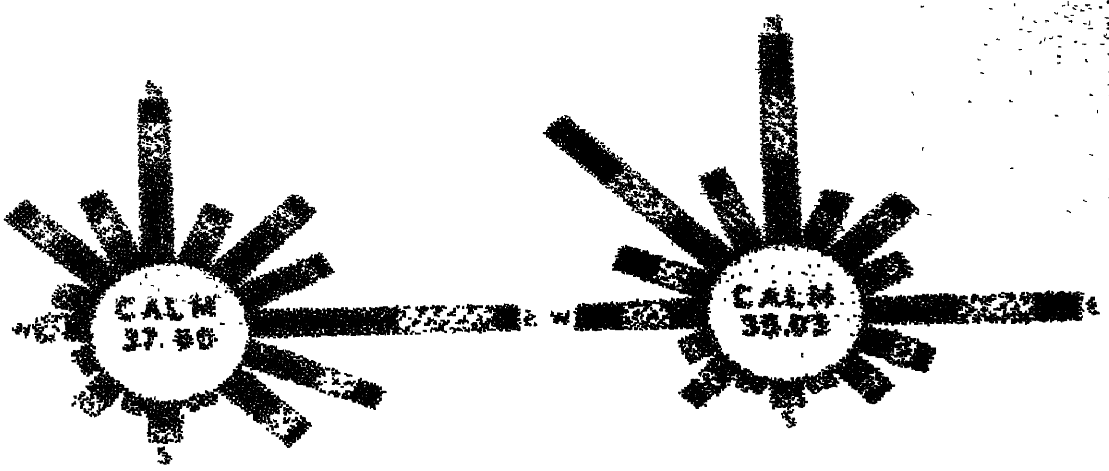


SEASONAL-ANNUAL WIND ROSES FOR JAIPUR - 1995



MONSOON

SUMMER

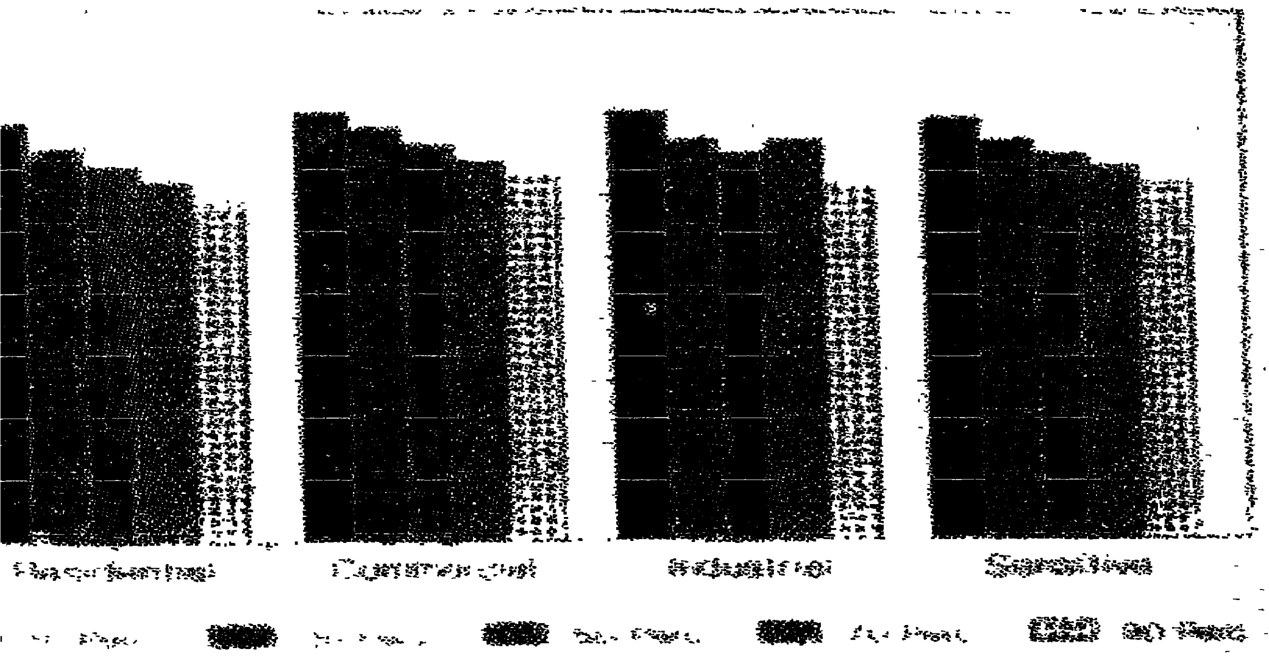


WINTER

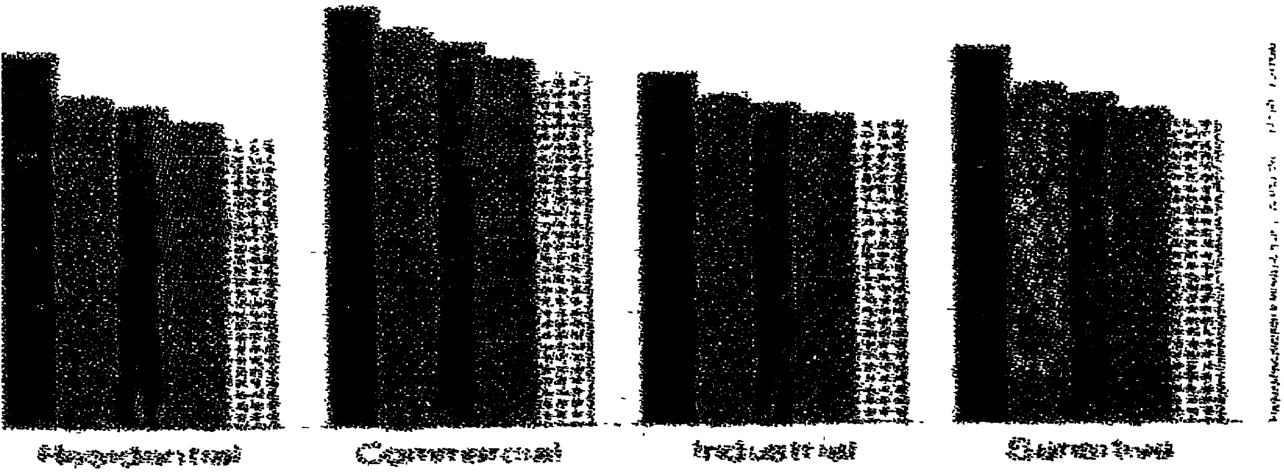
ANNUAL

ANNEXURE-12

BIENT NOISE LEVEL PERCENTILES
Day Time of Jaipur City

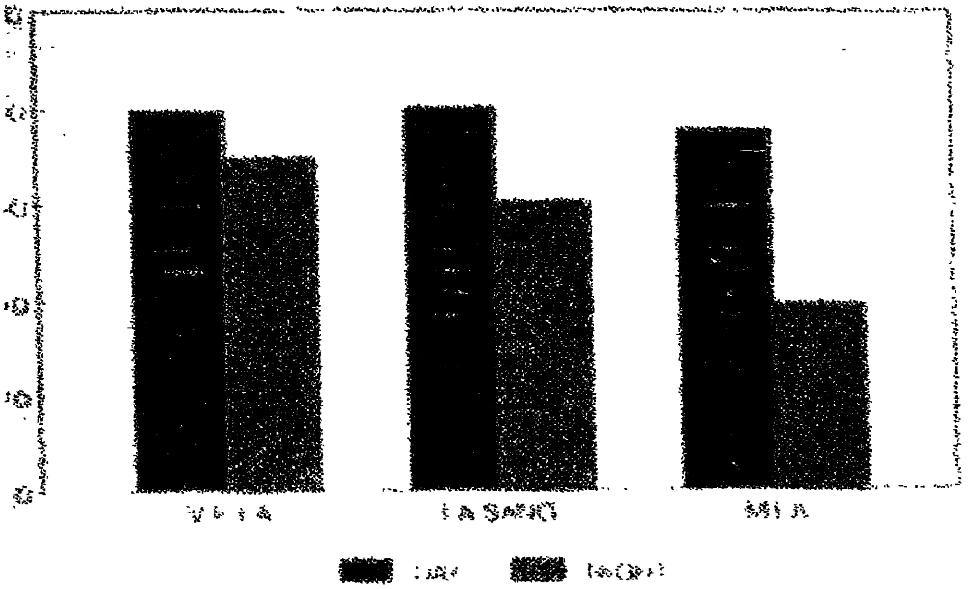


MBIENT NOISE LEVEL PERCENTILES
Night time of Jaipur City

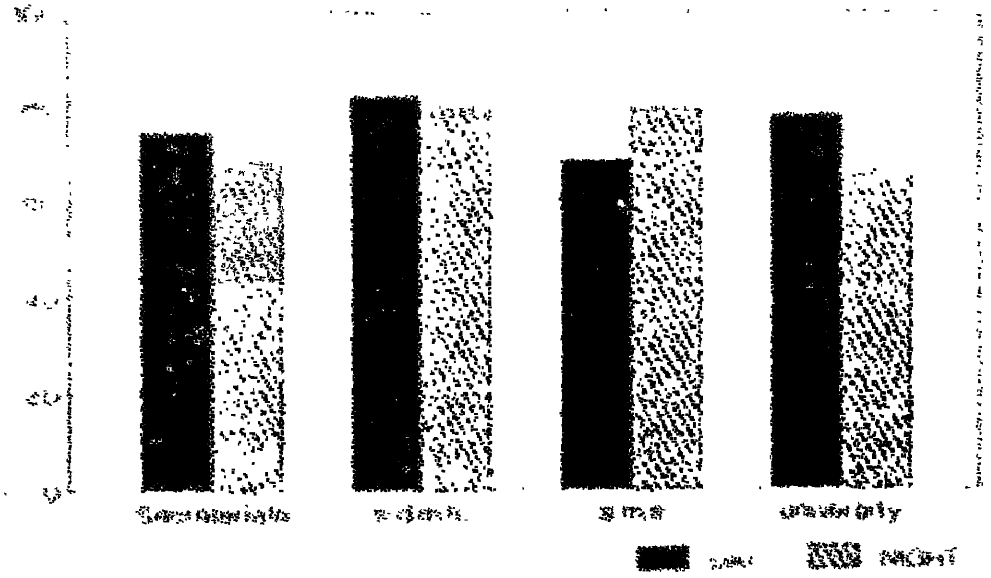


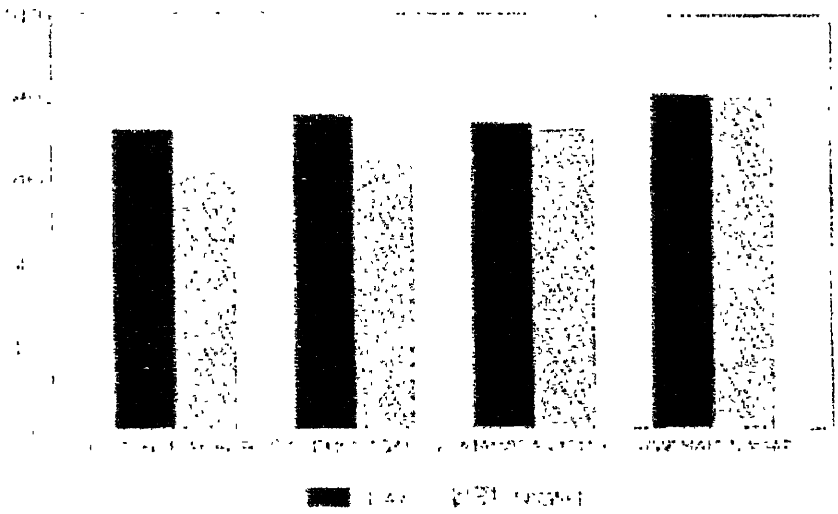
ANNEXURE-13

Histogram showing Ambient Noise level
of Industerial in Jaipur City

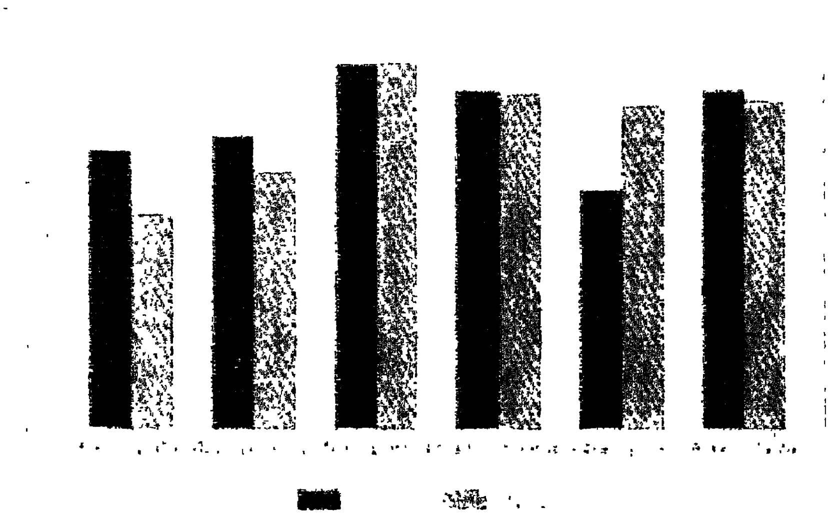


Histogram showing Ambient Noise level
of Silence Zone in Jaipur City



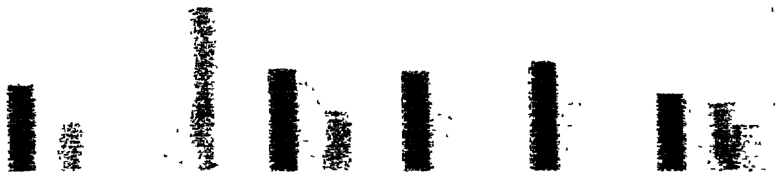


Histogram showing Ambient Noise level
of Residential Zone in Jaipur City



Histogram showing Ambient Noise level
of commercial in Jaipur City

ANNEXURE-15

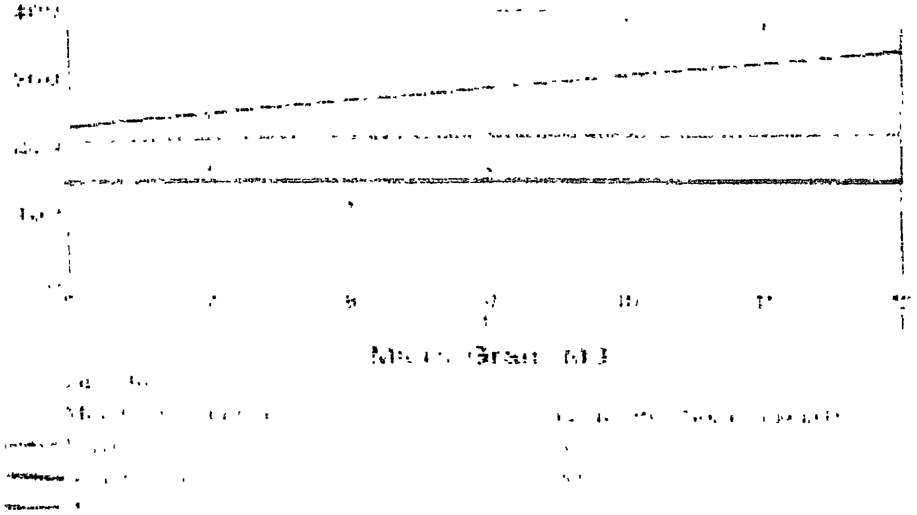


Ambient Air Quality At Jaipur

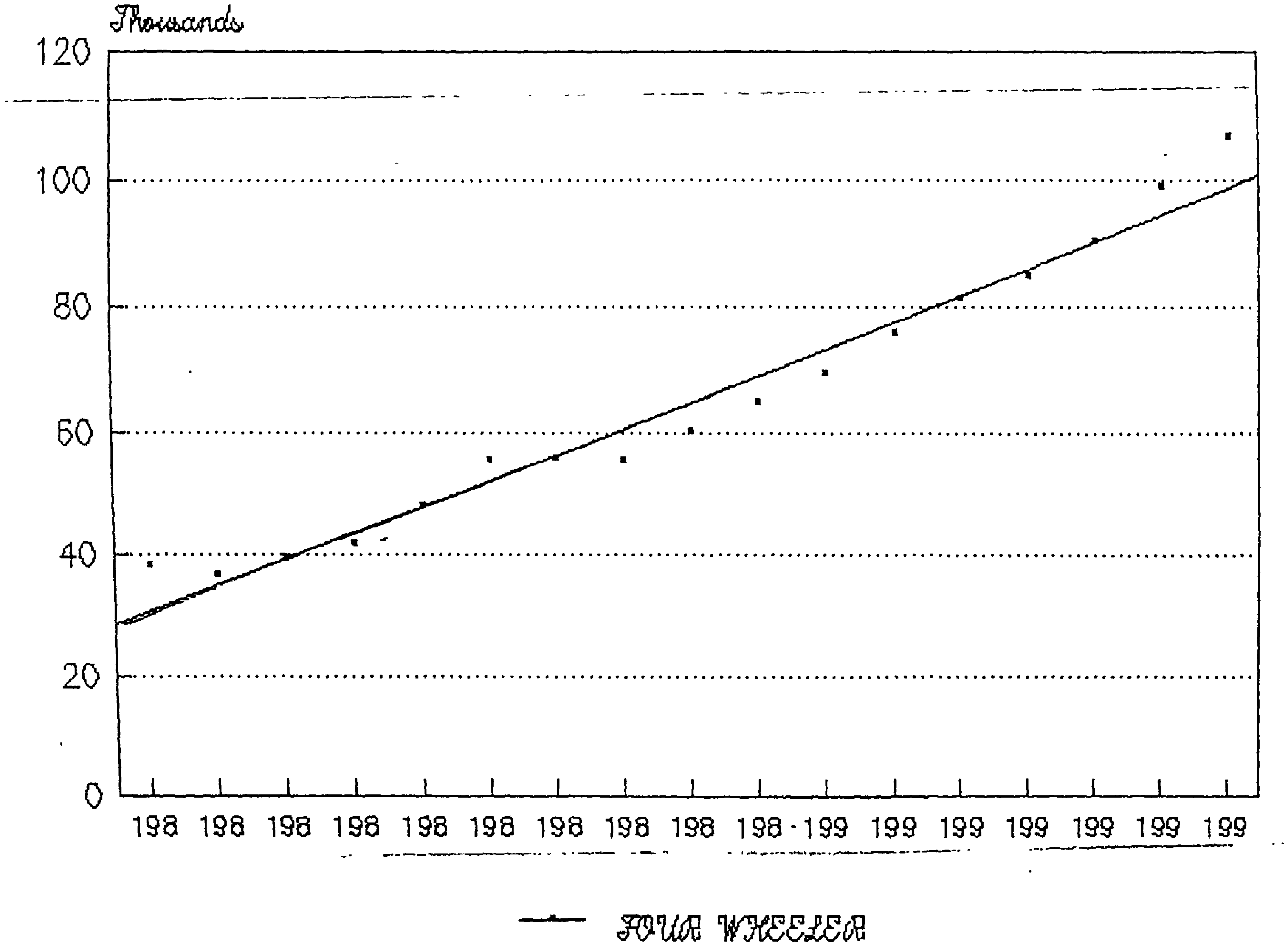
NOX Levels

ANNEXURE-18

Ambient Air Quality At Jaipur
SPM Levels

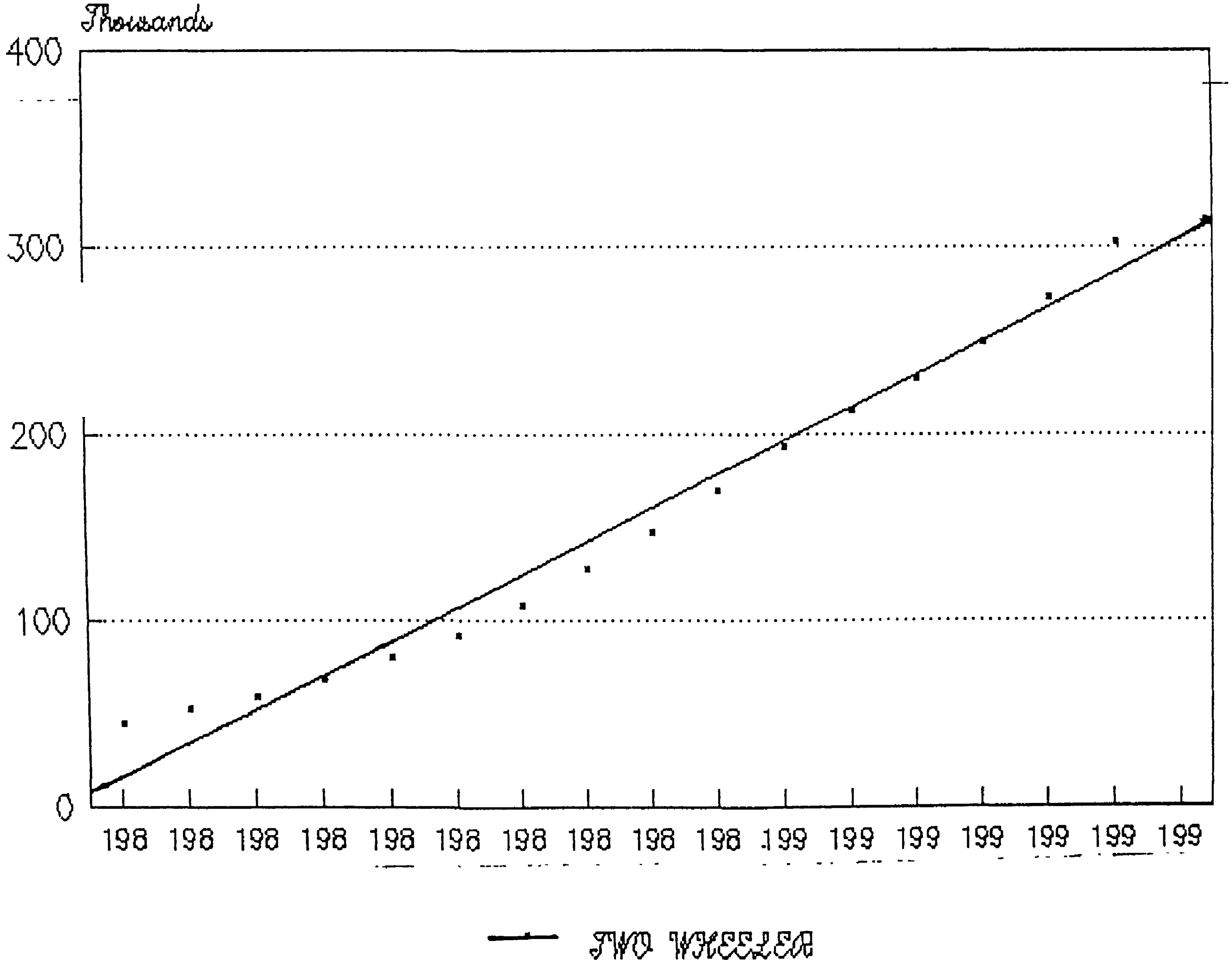


Registred Vehicles in Jaipur district
up to 31st, March

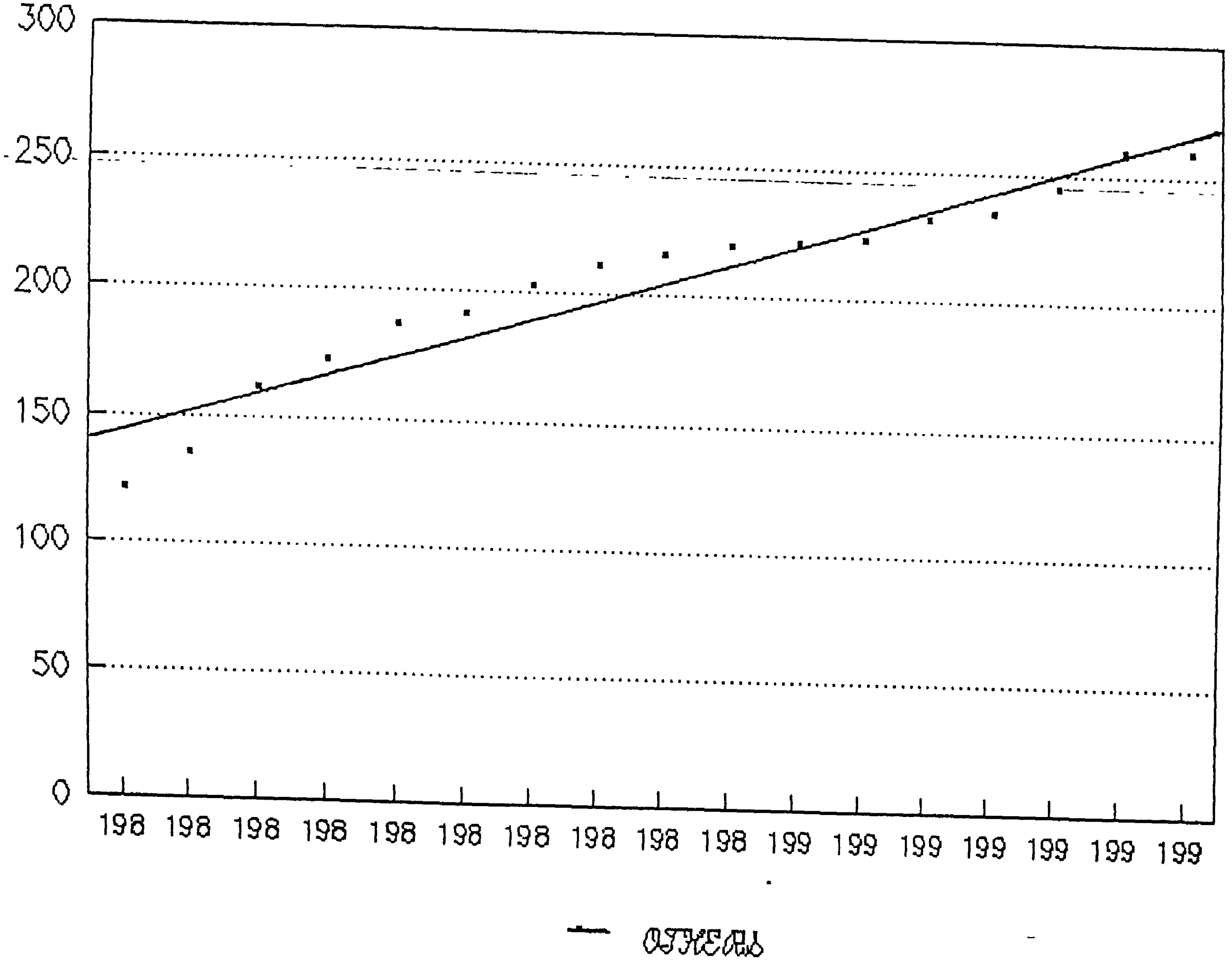


Registred Vehicles in Jaipur district

up to 31st, March



Registred Vehicles in Jaipur district
up to 31st, March



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Final Project Report

Common Effluent Treatment Plants and Sustainability

Submitted by
Ms Rita Pandey

April 1998

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COMMON EFFLUENT TREATMENT PLANTS AND SUSTAINABILITY

BY

RITA PANDEY

APRIL 1998
NEW DELHI

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INTRODUCTION 1

1.1 Rationale for Common Effluent Treatment Plants

Under the Water (prevention and Control of Pollution) Act of 1974, every industry has to provide adequate treatment for its effluents before its disposal. The Act prescribes both general and industry specific standards for the discharge of various pollutants into water bodies. Discharge of wastewater, carrying pollutant concentration beyond the specified standards into surface water, on land for irrigation and marine coastal waters, is prohibited. The Act lays down penalties for non-compliance.

In India, as in many other countries small scale firms contribute significantly to the total industrial water pollution generated. However, the studies[1] have revealed that the small scale firms find it very difficult to meet these standards owing to financial, manpower and land availability constraints. The problems faced by them are manifold in nature. Wastewater of individual industries are sometimes highly toxic and to reduce them by individual treatment to the desired concentration is difficult because of unavailability of adequate technology. In small scale units which generally operate one shift a day, maintenance of ETP is difficult and may not be financially viable also. Moreover, due to scarcity of land on the industrial site, it is extremely difficult to spare or acquire land for the individual treatment plant. As a result, majority of these units either do not have any treatment plant at all or are using inefficient pollution abatement technologies. The inability to comply with the prescribed standards has resulted in closure of many small scale industries.

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[1] See Gupta, Murty and Pandey (1989) and Murty *et. al.* (1996).

As these units are large in number and often scattered enforcing any control measures on these are often costly. In such cases to lower the costs of monitoring and enforcement, promotion of common effluent treatment plant (CETP) for treatment of industrial wastewater is often suggested. Also, due to presence of scale economics in water pollution abatement the CETP is considered a cost effective alternative to effluent treatment undertaken by individual small scale units. Combined treatment of industrial and municipal wastewater has some additional advantages as domestic sewage contributes nutrients and diluting potential, making the industrial waste more amenable to degradation (NEERI 1991).

1.2 Objectives

The objectives of the study are to:

(i) Review the methods used in sharing of costs and the experiences of the functioning of the CETPs in India and other countries; and,

(ii) Suggest a method for sharing of cost among participating agents/firms.

In doing the (ii) above, a case study of a CETP at Jajmau, Kanpur is undertaken.

LEGISLATION AND INCENTIVES 2

2.1 Introduction

The problem of water pollution due to discharge of industrial waste has already become a serious problem in the country. The rapid industrialisation and the consequent discharge of industrial waste into inland water bodies have resulted in heavy pollution of our natural water resources.

With a view to protect our water environment, the government has taken a variety of policy measures in the form of laws prohibiting discharge of polluting substances beyond specified standards into surface waters, public sewers, marine coastal water and on land for irrigation. A system of penalties has also been laid down for non-compliance. These regulatory measures have been supplemented by government interventions in terms of direct expenditures and fiscal incentives for pollution control. In this section, we review the regulations and fiscal incentives for industrial water pollution abatement in order to examine whether they are enough to ensure compliance , specially for the small scale industries.

2.2 Water (Prevention and Control of Pollution) Act

The Water Act, 1974, the **Environment Protection Act, 1986** and the **Environment Protection Rules 1986** were made to provide for the prevention and control of water pollution.

- Under the Water Act of 1974 made it mandatory for every industry, discharging its pollutants into streams, wells, sewers or on land, to take

consent from the State Pollution Control Boards (Section 25 & 26). The State Board may grant its consent subject to such condition as it may impose regarding the point of discharge of sewage, the nature and composition, temperature, volume or rate of discharge of the effluent (Sub-section (4) of Section 25).

- If any industry is found discharging its effluents without the consent of the State Board, the State Board may serve a notice imposing any such condition as it might have imposed on an application for its consent in respect of such establishment, such outlet or discharge (sub-section (5) of section 25).

- In case of excessive pollution (the standard has to be laid down by the State Boards) of stream or well, the State Boards have been given the power to issue orders immediately restraining or prohibiting the persons concerned from discharging any poisonous, noxious or polluting matter (Section 24 & 32).

- The State Boards have also given the power to direct the closure, prohibition or regulation of any polluting industry operation or process or the stoppage or regulation of supply of electricity, water or any other service (Section 33A).

- The Act has also laid down penalties for non-compliance.

2.3 Water Cess Act

The Water Cess Act of 1977 empowers the State Pollution Control Boards to levy a cess on local authorities supplying water to consumers and on

consumption of water by specified industries. The rate varies depending upon the purpose for which water is consumed - a higher rate is charged for uses which make the water more polluted. The Act also provides for a 25 percent rebate on the cess payable by the industry if (i) it conforms to the pollution standards prescribed under the Environment Act,1986, and (ii) it consumes water in quantity less than or equal to the maximum specified quantity in the Schedule.

The water cess has features of both a resource tax and effluent tax. However, it has thus far been unable to serve either purpose. The rate of cess is too low to have any impact either on consumption of water or on the effluent discharged by the industrial units. Moreover, most of the SSIs are not even aware of the provision of rebate in water cess. So, the water cess is unlikely to have met with any success in controlling water pollution.

An important feature of the Water Acts is the provision of appeals against the orders made by the State Boards . The Environment Act of 1986, however, has put any such appeal beyond the jurisdiction of civil courts (Section 22).[1]

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[1] It is interesting to note here, that the Supreme Court in the case of M.C. Mehta vs. Union of India, in a question raised by Pollution Board relating to quick obtaining of stay orders from High Court, held as under:

"It is admitted before use that whenever the board constituted under the Water Act initiates any proceedings to prosecute industrialists or other persons who pollute the water......, the persons accused of the offences immediately institute petitions... in the High Court and obtain stay orders thus frustrating the attempts of the Boards to enforce the provisions of pollution of the Water Act...... We are, however, of the view that since the problem of pollution of the water in the river Ganga has become very acute, the High Courts should not ordinarily grant orders of stay of criminal proceedings in such cases and even if such an order of stay is made in an extraordinary case, the High Courts should dispose of the case within a short period, say about two months, from the date of the institution of such case".

In a brief, the Environment Pollution Laws in India have empowered the Central and State Pollution Control Boards to take action against the polluting industries. The process involves:

- First identifying the erring industry, and then serving them with notice.

- If they continue to pollute even after that, then only action can be taken against them.[2]

However, the problem that the Central and State Pollution Control Boards face is that it is difficult for them to monitor the activities of the large number of small scale units spread throughout the country. Under such a situation, the regulatory regime comprising of pollution standards and penalties fails to make much impact, as the success of such a regime crucially depends upon strict monitoring of the polluting industries. Moreover, the provision of appeal against the orders of the pollution control boards has further reduced the effectiveness of such a regime, as the erring industries immediately institute petitions and obtain stay orders thus frustrating the attempts of the boards to enforce the provisions of the pollution laws.

The regulations pertaining to industrial water pollution control, discussed above, are supplemented by many fiscal incentives with an objective to encourage pollution abatement. These fiscal incentives are:

- Specified pollution control equipments are allowed tax depreciation. Preferential treatment regarding tax depreciation on pollution control equipments was first introduced in 1983. In 1983, the rate of depreciation

---

[2] There are instances, where judiciary has ordered the closure of different industrial units due to excessive pollution hazards

for pollution control equipments was 30 percent of the written down value as compared to the usual rate of 25 percent applicable for general plant and machinery. This was raised to 50 percent in 1987-88 budget, reduced to 40 percent in 1992-93 and raised to 100 percent in 1993-94.

- Until recently, under the Customs Tariff Act, import of specific pollution control equipments was allowed at concessional rate of duty of 25 percent. This concession has been withdrawn since August,1996.

- Domestically produced goods are subject to excise duties. Since March 1992, specified pollution control equipments manufactured in India are eligible for a rebate in Central Excise duty, at a maximum rate of 5 percent.

- In addition to the rebate on excise duties several states also provide rebates on sales taxes for specified pollution control equipments.

- Financial Assistance is provided to SSIs for adoption of clean technologies.

- Loans, conditional grants and technical assistance are provided under the USAID funded TEST (Trade in Environmental Services and Technologies) programme to Indian firms to collaborate with US companies for pollution control technologies and services.

- Grants from the Central and the State governments and low-interest loans from Financial Institutions are available to SSIs for setting up Common Effluent Treatment Plants.

It is clear from the discussion above that economic incentives of the general nature provided in current legislation are inadequate to make an impact on water pollution control especially in the context of SSIs. Incentives provided for setting up CETPs are however substantial and seem to make the scheme cost effective for SSIs.

PROCEDURES IN SETTING UP CETP 3

The CETP promotional scheme has been instituted by the Ministry of Environment and Forests (MEF), under the World Bank aided 'Industrial Pollution Control Project' to provide financial assistance for setting up CETPs in industrial estates/SSI clusters. All proposals for loan and grant assistance have to fulfill certain eligibility criteria.

In an industrial estate or cluster of SSIs, only one CETP can be promoted and only cluster of SSIs set up prior to 1.1.1990 are eligible for the scheme. The Promoter Company/Society set up for implementing and commissioning the CETP, has to undertake a thorough survey of the effluent situation at the site and make provisions for adequate pre-treatment or disposal of effluents not suitable for common treatment. A feasibility study regarding the economic and financial viability has to be conducted since the project should be self-financing for servicing the loan and meeting operation and maintenance costs. In addition, the project must enunciate adequate institutional arrangements for the management, cost sharing, recovery of dues and ensure observance of prescribed standards.

Once the above conditions are fulfilled, the Promoter Company/Society has to submit proposal in prescribed form to the concerned SPCB for approval. The project proposals are prioritised on the basis of toxicity of pollutants, pollution load proposed to be treated and number of units covered. After the approval of the proposal by the concerned SPCB, the Promoter Company/Society needs to submit the proposal to IDBI and NEERI with a copy to MEF. NEERI reviews the proposal and the detailed engineering design on behalf of MEF and if satisfied after discussion with the Company/Society, forwards the technical clearance to IDBI and MEF. The financing plan of the project is approved by the IDBI, after which the IDBI

sanctions the loan assistance and advises the Company/Society, MEF and the concerned SPCB about acceptance of the proposal and the final cost of the project. Steering Committee of the MEF formally approves the release of grant component (25% of the total cost of CETP) in the financing plan and intimates the State Government for release of matching grant[1]. IDBI also needs to submit the project proposal to IBRD for approval. The grants from the GOI and State Government as well as loan funds from World Bank (30% of total cost) are released by the IDBI and channelled through the SPCB concerned to the Company/Society[2]. The SPCB monitors and reports on the progress of scheme to the Government.

According to the procedural requirements, the initiative for setting up of CETP has to be taken by the Promotor Company/Society. If this Promotor Company/Society is a co-operative or association of the participating industries, it implies that the initiative is coming from the polluting industries. On the contrary, if any government or semi-government body plays the role of the Promotor Company/Society, in that case, it is the government who is taking the initiative. The table below, provides information in respect of 22 CETPs about who has taken the initiative in setting up these CETPs.

Existing CETPs As Well As CETPs Under Consideration of GOI

Name/Location of CETP	Promotor Company/Society
1. CETP at Mallapur, A.P.	Andhra Pradesh Industrial Infrastructure Corporation (APHC)

---

[1] Initially 25% of the total assistance is released. The second instalment of 50% and the last instalment of 25% are released only when utilisation certificates for the previous instalments have been submitted and duly verified by the SPCBs, subject to release of proportionate shares by the State Governments.

[2] The entrepreneurs of CETP need to bear 20% of the total cost.

Name/Location of CETP	Promotor Company/Society
2. CETP at Nacharam, A.P.	APHC
3. CETP at Pyara Nagar, Medak, A.P.	M/s Bonthapally Envirotech Pvt. Ltd.
4. CETP at Bollaram, A.P.	M/s. Progressive Effluent Treatment Ltd.
5. CETP at Ankaleshwar Estate, Gujarat	Gujarat Industrial Development Corporation (GIDC)
6. CETP at Vapi Industrial Estate, Gujarat	GIDC
7. CETP for industrial waste water at Jeedimetla, A.P.	Jeedimelta Effluent Treatment Ltd. APIIC - nodal agency (took the initiative)
8. CETP at Pattancheru, A.P.	Pattancheru Enviro Tech Ltd. APIIC - nodal agency (took the initiative)
9. CETP at Pashamylaran, A.P.	APIIC
10. CETP for cluster of dying industries in Textile Colony, Industrial Area `A', Ludhiana, Punjab	Punjab Water Supply & Sewerage Board
11. CETP for cluster of textile mills at Batala Road, Amritsar, Punjab	Punjab Water Supply & Sewerage Board
12. CETP for cluster of dying industries, Rahon Road, Ludhiana, Punjab	Punjab Water Supply & Sewerage Board
13. CETP for cluster of electroplating industries, Gill Road, Ludhiana, Punjab	Punjab Water Supply & Sewerage Board
14. CETP at Panoli Dist. Bharuch,	GIDC

Name/Location of CETP	Promotor Company/Society
Gujarat	
15. CETP at Sarigam, Valsad, Gujarat	GIDC
16. CETP at Sachin, Gujarat	GIDC
17. CETP at Tarapur, Maharashtra	Maharashtra Industrial Development Corporation (MIDC)
18. CETP at Trans-Thane, Maharashtra	MIDC
19. CETP at Pali, Rajasthan (non-functional)	Rajasthan Industrial Investment Corporation (RIICO)
20. CETP at Vaniyambadi, Tamil Nadu	VANITEC
21. CETP at Nandesari, Gujarat	GIDC (in Nov. 1994, Nandesari Industries Association took up the operation and maintenance of the CETP)
22. CETP at Jajmau, Kanpur	Uttar Pradesh Jal Nigam (UPJN)

It can be seen from the above table that in the majority of the cases the initiative for construction of CETP has come from different government bodies and in most of the cases operation and maintenance of CETPs has remained with the promoter company. However, there are a few exceptions, for example, the case of CETPs at Pattancheru, Jeedimelta and Nandesari, where though the initiative was taken by the APHC and GIDC respectively, the CETPs have been finally handed over to the respective industries association for operation and maintenance. In other cases, the CETPs are still managed by different government bodies. However, so far as compliance of environmental standards are concerned, this type of public management of

CETP creates a peculiar institutional problem. It becomes difficult for the concerned SPCB to take action against another government agency for either non-compliance of standards or for any other matter. Thus, pollution continues and the public money spent on treatment plant construction remains infructuous.

COST SHARING ARRANGEMENTS 4

4.1 Introduction

Once the proposal for setting up of a CETP is approved, the CETP project is entitled to grants from the Central and the State Governments as well as loan from IDBI or other financial institutions.

The assistance is provided only in respect of capital costs of the CETP. Which implies that the promoter company/society and/or members of the scheme have to bear the operation and maintenance cost of CETP. The crucial question remains that on what basis will the cost be shared among the member units of the scheme. In this section, we first review the status of cost sharing in CETPs, both capital as well as O&M costs, in India and abroad. This is followed by a theoretical discussion on different financial apportionment methods.

Under the World Bank aided 'Industrial Pollution Control Project', the funding of the CETP project until recently, used to be as follows:

GOI Grant	State Govt. Grant	IBRD loan from IDBI/ICICI	Entrepreneurs Contribution	Total
20%*	20%*	40%	20%	100%

* 20% subject to a ceiling of Rs. 50 lakh.

The grants from Central and State Governments were limited to SSIs but the IBRD loan included SSIs and the medium scale units in a cluster.

However this has been changed (office Memorandum No. 14011/1/96-

WB Cell, GOI, MEF). The ceiling on subsidy available from the state and the Central Government has been removed. The present financing pattern of the CETPs is as under:

GOI Grant	State Govt. Grant	IBRD loan from IDBI/ICICI	Entrepreneurs Contribution	Total
25%	25%	30%	20%	100%

The following table reveals the capital cost sharing arrangements of different CETP schemes already implemented or under consideration of GOI.

Cost-Sharing Arrangements of CETP Schemes

Already Implemented or Under Consideration of Government of India

S.No	Name/Location of CETP Scheme	Sharing of Costs			
		Central Govt.	State Govt.	Financial Institution	Member of the Scheme
1.	CETP for Mallanpur, A.P.	25%	25%	50%	-
2.	CETP for Nacharam, A.P.	25%	25%	50%	-
3.	CETP for cluster of tanneries in T.N.				
	(i) Pammal & Pallavaram	25%	25%	40%	10%
	(ii) Erode	25%	25%	40%	10%
4.	CETP for Dyeing units in T.N.	25%	25%	40%	10%
5.	CETP for Bollaram, A.P.	25%	25%	50%	
6.	CETP for Vapi, Gujarat	20%	20%	50%	10%
7.	CETP for cluster of tanneries at Kadugondama, Bangalore, Karnataka	25%	25%	45%	5%
8.	CETP at Jeedimelta, A.P.	25%	25%		50%
9.	CETP at Govindpura, M.P.	25%	25%	50%	

S.No	Name/Location of CETP Scheme	Sharing of Costs			
		Central Govt.	State Govt.	Financial Institution	Member of the Scheme
10.	CETP for cluster of dyeing industries in Textile colony, Industrial Area `A', Ludhiana, Punjab	25%	25%	40%	10%
11.	CETP for cluster of textile mills at Batala Road, Amritsar Punjab	50%	-	40%	10%
12.	CETP for cluster of dyeing industries along Rahan Road, Ludhiana, Punjab	25%	25%	40%	10%
13.	CETP at Panoli, Dist. Bharuch, Gujarat	25%	25%	40%	10%
14.	CETP for Sarigam, Valsad, Gujarat	25%	25%	40%	10%
15.	CETP for Sachin, Gujarat	25%	25%	40%	10%
16.	CETP at Jayasingpur Industrial Cooperative Estate Ltd., Kolhapur, Maharashtra	25%	25%	40%	10%
17.	CETP at Vaniyambadi, T.N.	25%	25%	35%	15%
18.	CETP at Kanpur	65% by NRCD[1]	17.5%	-	17.5%

It can be seen from the above table that in majority of the cases, the share of the participating units is of the order of 10% which is less than the stipulated share of 20%. In these cases, the gaps have been filled up by loans from the financial institution. A notable exception is the CETP at Jeedimelta where the member units share as much as 50% of the total cost. The reason for low contribution on the part of the industries is that the initiative for setting up the CETP has not come from them.

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[1] NRCD - National River Conservation Directorate.

4.2 O & M Cost Sharing

Sharing the O & M cost is of crucial importance for efficient functioning of CETPs. Equitable sharing should be the main objective while developing a financial apportionment method. Factors such as volume of effluent, and, quality of effluent are important determinants of O & M cost of a CETP. In this section, some of the cost sharing arrangements as prevalent in North America are discussed. This is followed by a discussion on cost sharing methods practised by different CETPs in India.

4.2.1 Joint Treatment Plant for the Williamsport Tannery of the Armour Leather Co., USA:

The rate schedule adopted by the Authority is based on water usage or volume of water discharged and applies to all wastes that do not contain suspended solids in excess of 300 mg/l. A surcharge is levied on those industries which discharge effluents containing suspended solids in excess of 300 mg/l. The surcharge varies according to the amount of the suspended solids in excess of the prescribed amount. The schedule of rates also provide for a 30% discount on the basic rate to any industry which delivers its wastes directly to the sewage treatment plant instead of public sewage collection system.

4.2.2 Bayport Central Waste Treatment System, Texas, USA

Bayport Central Waste Treatment System serves ten industries of heavy industrial class in Bayport Industrial Estate, Texas. Each waste stream is monitored for strength and volume regularly. Volume measurements are made by flowmeters with continuous recorders and grab samples are obtained at two or four hour intervals. A seven day composite is made from the grab

samples of each respective stream and analysis of the composite alongwith volumetric measurements, serves as a basis for treatment charge. The waste treatment charges are scheduled to recover the operation cost, and a nominal return on the developer's investment. The schedule of charges is reviewed every year and necessary adjustments are made.

4.2.3 CETP at the City of Winnipeg

The CETP caters to a number of industries including tanneries and metal plating industries as well as domestic sewage. Wastewater from each source is monitored regularly for strength and volume. The CETP authority (which is a government body) may impose a flow restriction limit to control maximum discharge rates to any sewer or body of water. In general, a uniform sewer rate is charged to all users whose wastewater has a biochemical oxygen demand within 300 mg/l and/or contains total suspended solids less than or equal to 350 mg/l. Any person or industry discharging overstrength wastewater into any city sewer is required to take an Overstrength Wastewater Discharge License from the CETP authority in advance. A person discharging such wastewater has to pay a surcharge over and above the uniform sewer rates. The surcharge is calculated as follows:

$$S = Q.R \text{ and}$$

$$R = [\frac{f_s(S_i - S_n)}{S_n} + \frac{f_p(P_i - P_n)}{P_n}].R_n$$

where

S = surcharge in dollars

Q = discharge to sewer in kilolitres for the billing period

R = surcharge rate, dollars per kilolitre

f_s = factor derived from costs of reducing total suspended solids

f_p = factor derived from costs of reducing BOD

S_i = total suspended solids (mg/l) of wastewater (minimum 350 mg/l)

P_i = BOD (mg/l) of wastewater (minimum 300 mg/l)

S_n = total suspended solids (mg/l) of normal wastewater (350 mg/l)

P_n = BOD (mg/l) of normal wastewater (300 mg/l)

R_n = unit charge based on cost of treating normal wastewater, in dollars per kilolitre

The CETP authority estimates the cost of treating the wastewater expected during the next one year. The factor R_n is computed based on the cost of treating normal wastewater. The factor f_s is estimated fraction of R_n associated with total suspended solids removal. The factor f_p is estimated fraction of R_n associated with BOD removal.

The participating members can ask for an adjustment in charges for which they have to pay in advance the fees for the purpose of recovering the cost for administration, field investigation, meter inspection as well as the fee for the chemical analyses of the wastewater.

4.3 CETPs in India

4.3.1 CETP at Vaniyambadi, Tamil Nadu:

The fixed charges are collected from the tanneries based on their production capacity as per the details given in table.

Production Capacity (Kg/day)	Fixed Charges (Rs.)	No. of Tanneries in the Production Range
200	60	1
250	60	2
400	60	1
500	85	43
750	125	7
1000	170	23
1500	250	1
2000	350	2
3000	600	2

Variable charges are to be submitted to VANITEC (Promoter Company) based on actual hide processing capacity ascertained by VANITEC at the rate of Rs. 0.10 per kg.

4.3.2 CETP at Nandesari, Gujarat:

For the primary treatment plant, the annualised fixed costs are shared on the basis of net profits as follows:

Net Profits	% of annualised fixed costs to be shared
50 lakhs and above	80%
20 - 50	10%
10 - 20	7.5%
0 - 10	2.5%

The variable costs are shared on the basis of Re. 0.50 per KL of water consumed.

For the secondary treatment plant, fixed costs are shared on the basis of Rs. 3/KL of water consumed. The variable costs are shared on the basis of Rs. 1.30/KL of water consumed. The secondary treatment plant assures cost sharing or a proportional basis.

4.3.3 CETP at Patancheru, Andhra Pradesh:

Operating costs (and debt servicing charges) are recovered from users based on wastewater volume and BOD. The individual members are required to provide pretreatment before releasing the wastewater to the CETP. These industrial wastes not meeting standards would not be allowed to discharge into the CETP.

4.3.4 CETP at Jeedimetla, Andhra Pradesh:

The individual industrial members have to neutralise their wastewater before filling it up in the tanker and also to bring oil and grease levels to the stipulated CPCB standards of less than 10 mg/l. As COD can be analysed relatively rapidly and easily, it was chosen as the parameter for calculating the financial burden to be shared by each member industry. The rate structure is as follows:

Quality of Effluent COD, mg/L	Rate in Rs. per tanker of 10000 litres or part thereof
1 - 5000	150
5001 - 10000	175

Quality of Effluent COD, mg/L	Rate in Rs. per tanker of 10000 litres or part thereof
10001 - 15000	200
15001 - 20000	225
20001 - 35000	250
Above 35000	Additional charge of Rs. 25 per tanker for every 1000 units of COD. However, for such high loads, specific prior approval to be obtained by the customer from the Treatment Company.

A fixed charge is levied on participating units, when they do not send effluents for treatment.

As may be noted here, that the effluents carried from member units by tankers instead of pipeline, is more appropriate to have better control over the discharge of effluent. It also ensures that the revenue collection is regular. The company can stop lifting the effluent if the units fail to pay its treatment cost or discharged effluents are not as per the parameters agreed upon.

4.3.5 CETP at Jajmau, Kanpur:

This is a joint treatment plant where wastes having admixture of tannery waste and domestic sewage are treated. Of the total O & M cost is 60 percent to be borne by the tanneries. Rest 40 percent is borne by Nagar Nigam. However, the full cost of the conveyance system is borne by the tanners.

A procedure based on the volume and degree of noxiousness of wastewater is used for equitable distribution of annualized financial burden. Since the combined treatment is biological in nature, wastewater dilution factor, V to ensure survival of fish (48 hours exposure) is expressed as:

$$V = \frac{A}{A_o} + \frac{1}{2}\left(\frac{B}{B_o} + \frac{C}{C_o}\right) + F - 1$$

where A = settleable matter in wastewater (mg/L)
B = BOD of settled wastewater (mg/L)
C = COD of settled wastewater (mg/L)
F = Fish toxicity factor

A_o, B_o, C_o = effluent standards set by UP Pollution Control Board for settleable matter, BOD and COD (mg/L).

Noxiousness degree, S, is then estimated from dilution factor, V, expressed in appropriate slabs rather than in discrete numbers to account for deviation in sampling and analysis of wastewater.

V	1 - 4	5 - 8	9 - 12	13 - 16	17 - 20	21 - 28	29 - 36
S	1	2	3	4	5	6	7

Annualised cost apportioned to each polluter is calculated as:

Annual Apportionment = S x annual flow x total annualised cost of joint wastewater collection and treatment system per unit flow.

The average annualised cost to be shared by the tanneries is listed below.

Average Annual Financial Burden

Maximum Hides Processing Capacity (Hides/day)	Average Flow per tannery (m^3/day)	Annualised Financial Burden (Rs.)
> 250	354	43,395.37
50 - 250	107.74	52,829.56
< 50	25.01	6.131.74

4.4 Observations

The financing procedure of the CETPs requires that at least 20 % of the total cost of the project has to be borne by the member units of the scheme. However, in majority of the CETP schemes, the share of the participating units varies between 5 to 15%, with the gaps being filled up by loans from the financial institutions. In some cases, the member units have not made any contribution at all. One of the important reasons for low or no contribution on the part of the industries is the lack of initiative for setting up CETP on the part of industrial units which, in turn, is a result of the absence of incentive mechanism for the polluting small scale industries to control pollution.

So far as the O & M cost is concerned, it has two components. One is the fixed cost and the other is the variable cost. The fixed costs are charged mostly on the basis of either production capacity or net profits. In other words, it is indirectly related to the volume of effluents. The variable cost component is also charged, mostly on the basis of volume of effluent. However, the practice of charging on the basis of volume of effluent appears to be due to administrative convenience. This method of charging ignores the characteristics of waste water which is an important determinant of the total O & M cost of abatement[2]. Since CETPs are designed for the treatment of given

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[2] See Pandey (1996) and (1998).

quantity and quality of effluents, overstrength waste water as well as greater volumes would affect the efficiency of CETP. High unmonitored pollution load is a major factor responsible for the poor functioning of CETP in India. Moreover, this system of charging does not give any incentive to the participating industries to use cleaner technologies. Under a system based on pollution load, the industries will have an incentive to upgrade their production technology, thereby improving upon their effluent quality and the consequent savings in their share of abatement costs.

COST SHARING: A THEORETICAL PERSPECTIVE 5

5.1 Introduction

Theoretically, it may be useful to distinguish between two different types of tariffs, serving a different purpose. First, tariffs charged to cover the costs of the treatment of wastewater. These are also called user fees, since these represent a fee for a service used. Second, tariff aimed at persuading the entrepreneurs to reduce their pollution load or regulatory tariffs.

In the case of the CETPs, the main objective while developing a cost sharing method should be equitable sharing of cost. Since, the major part of the capital cost comes as a grant and a loan, the main issue is to distribute the O & M cost among the member industrial units; such that no industry is benefitted at the cost of other industry.

The CETP at Kanpur is a joint treatment plant where waste water having admixture of tannery waste and domestic sewage are treated. According to the agreement between the Government of UP, the municipality of Kanpur and the Government of India, 40 per cent of the O&M costs is to be borne by the Kanpur Jal Sansthan (KJS), the municipal body responsible for domestic sewage and water supply. The remaining 60 per cent is to be borne by the tanners. It is reported that the tanners were not a party to this agreement.

However, considering the fact that the contribution of domestic sewage to the CETP is 27 MLD as opposed to 9 MLD for tannery effluent, the tanners have reportedly shown resentment to the above mentioned cost sharing system where they have to bear 60 per cent of the total O&M costs, while they contribute only one-fourth of the total effluent.

The following section, examines the present cost sharing arrangements between the municipality and the tanners, and among the tanners, and suggests an alternative cost sharing method.

5.2 Cost Sharing between the Municipality and the Tanners:

To find out the cost share between the tanners and the municipality, we have used a variation of the Quantity-Quality method where both the quality or concentration of the wastes in terms of BOD and suspended solids as well as volume is considered in computing the unit treatment cost.

A sewage treatment plant has some major components like sewers and pumping stations, sedimentation tank, bricking filters, sludge digestion bed etc. Each of these serves one or more purpose in treating the wastewater. So, the annualised fixed cost and operating costs on each of these plant components can be apportioned to different design parameters like total volume of flow handled, BOD, COD treated suspended solids removed etc. Once the total annual cost is thus apportioned, the annual quantities of different parameters (like volume, BOD, SS) in terms of design basis is used to calculate their respective unit treatment costs. These unit costs form the basis of calculating cost per KL of wastewater treated, once the composition of waste is known or some assumption is made regarding that.

The above cost formulation can be expressed by the following equation:

$$C_i = f_v + \frac{q_i^s}{1000} \cdot f_s + \frac{q_i^b}{1000} \cdot f_b \qquad (1)$$

where C_i = unit cost per KL of effluent of the ith industry

f_v = unit cost based on volume (Rs./KL)
f_s = unit cost based on suspended solids (Rs./kg. SS)
f_b = unit cost based on BOD (Rs./kg. BOD)
q_i^s = suspended solids in the wastewater of the ith industry (mg/l)
q_i^b = BOD in the wastewater of the ith industry (mg/l)

Total cost share of the ith industry is calculated as

$$S_i = Q_i . C_i$$

where S_i = annual cost share of the ith industry
Q_i = annual flow of wastewater from the ith industry

This method allows equitable cost sharing among the participating agents. However, it is difficult to administer as it requires constant monitoring of effluent quality and quantity of the individual users of CETP. Considering this, it may be useful to simplify this to make its implementation easy. In order to do so, tariff for each participating agent can be calculated in two steps. In the first step, a base rate of tariff is calculated for the given characteristics of waste water. These characteristics of waste water can be fixed on the basis of the design Parameters of the CETP. The base rate tariff can be calculated as follows:

$$R_n = f_v + \frac{q_n^s}{1000} . f_s + \frac{q_n^b}{1000} . f_b \qquad (2)$$

All industries with a normal effluent[1] will be charged on the amount equivalent to Rn per KL of wastewater. In the second step tariff can be

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[1] Normal effluent is defined as the effluent having certain given characteristics of the waste water fixed by the authority responsible for running the CETP.

calculated for overstrength waste water. The tariff rate can be calculated as follows:

$$R = R_n + \frac{q_i^s - q_n^s}{1000} \cdot f_s + \frac{q_i^b - q_n^b}{1000} \cdot f_b \qquad (3)$$

Where q_i^s = suspended solids in the overstrength wastewater (mg/l)

q_n^s = suspended solids in the normal wastewater (mg/l)

q_i^b = BOD in the overstrength wastewater (mg/l)

q_n^b = BOD in the normal wastewater (mg/l)

Equation (3) can also be used to calculate the charge for an industry with a below normal strength wastewater, if that industry asks for an adjustment for the same.

In what follows, equation (1) has been used to calculate the approximate share of the tanners and the municipality in the case of Kanpur CETP. The values of f_v, f_s and f_b used are based on engineering cost calculations.[2]

f_v = Rs. 0.465/KL

f_s = Rs. 0.544/Kg.ss

f_b = Rs. 0.434/Kg.BOD

Using the above values. The unit cost of treatment of tannery wastewater and municipal wastewater has been computed. This is presented in the table below.

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[2] NEERI (1992)

Unit Cost of Treatment of Wastewater

	BOD	Suspended Solids	Unit Cost of Treatment (Rs./KL)
Tannery Wastewater	1100 mg/l	4000 mg/l	3.12
Municipal Wastewater	225 mg/l	600 mg/l	0.89

Source: Columns 2 and 3, U.P. Jal Nigam. Column 4, computed.

Now, if the volume of municipal wastewater is three times that of tannery wastewater, then the cost share of the tannery can be calculated as follows:

$$\%\ \text{Cost share of the tannery} = \frac{3.12}{3.12 + 0.89\text{x}3}$$

$$= 0.54 \text{ or } 54 \text{ per cent}$$

As per the above calculations, the tanners should bear 54 per cent of the total O & M cost. However, this result is at best an approximation and should be used with caution because if relative values of the cost parameters change the above result will change. In the absence of information on the actual values of the above parameters these values have been used only for an illustration.

5.3 Cost Sharing among the Tanners

This section, reviews the cost sharing method, currently used in the CETP at Kanpur and suggests an alternative financial apportionment method[3] which finds its genesis in the shortcomings of the existing method.

The cost sharing method used in Kanpur is based on modified Malz formulation. Malz formulation is based on the volume and degree of noxiousness of wastewater for distribution of annualized financial burden. According to the original Malz formulation, the cost-share of each polluter is calculated as follows:

$$\text{Cost} = S.Q.Z / \Sigma(S.Q)$$

Where, Q = Annual flow of an individual industry

Z = Total financial cost of collection and treatment (per unit of waste water)

S = Noxiousness degree[4]

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[3] For a detailed discussion on available financial apportionment methods, see NEERI (1992), Common Effluent Treatment Plant, State of the Art.

[4] S is estimated from dilution factor, V, expressed as

$V = A/A_0 + B/B_0 + TDS/TDS_0 + F - 1$

Where A = sedimentable matter, mg/l

B = COD of settled sample, mg/l

TDS = total dissolved solids, mg/l

F = fish toxicity

A_0, B_0 & TDS_0 = effluent discharge standards set by local governing body.

V so estimated is expressed in appropriate slabs rather than in discrete numbers to account for deviation in sampling and analysis of wastewater. Thus,

V	S
1-2	1
3-4	2
4-6	3
6-7	4

Cheda et al have modified this formula to use it for the Kanpur CETP. However, in the modified formulation the annualised cost apportionment is same as in the Malz formulation. The difference between the two formulae is with respect to the calculation of dilution factor.

The dilution factor, V, has been defined as

$$V = \left[\frac{A}{A_0} + \frac{1}{2}\left(\frac{B}{B_0} + \frac{C}{C_0}\right) + F\right] - 1$$

Where, A = settleable matter in wastewater, mg/l

B = BOD of settled wastewater, mg/l

C = COD of settled wastewater, mg/l

F = Fish toxicity factor

A_0, B_0, C_0 = Effluent discharge standards set by UP Pollution Control Board for settleable matter, BOD and COD respectively.

Noxiousness degree, S, has been determined from the following slabs of dilution factor, V values:

V	1-4	5-8	9-12	13-16	17-20	21-28	29-36
S	1	2	3	4	5	6	7

For the purpose of administrative ease, the tanneries has been classified into three categories based on daily hides processing capacity of the tannery.

Class A tannery = hides processing capacity per day > 250
Class B tannery = hides processing capacity per day 50 to 250
Class C tannery = hides processing capacity per day < 50

Once the tanneries have been so grouped, annual cost to each polluter in a particular class is calculated using average values of different parameters of that class and as well as other classes.

The following observations can be made on the above formulation:

1. Though the grouping of tanneries according to the number of hides processed to assess the tariff rate circumvents the problem of regular measurement of the flows and concentration of the effluent, the levy based on the hides produced looses its regulatory effect. The delinking of the amount to be paid in a particular production bracket from the actual pollution load produced, gives no incentive to the tanners either to undertake adequate primary of effluents or to use cleaner technologies.

2. Since this system of financial apportionment fails to take care of the differences in effluent characteristics within each group (which might be considerable), the principle of equitable sharing is violated. This has been illustrated with the help of the following tables.

The Tables 1, 2, and 3 present the chemical analysis of effluent samples from class A, B and C tanneries respectively. For each class, the dilution factor (v) for individual tanneries and the average `v' values for the samples has been calculated. In calculation of v, the fish toxicity factor has not been taken into account.

Table 1. Chemical Analysis of Effluent Samples from Class `A' Tanneries

Tannery	SS (mg/l)	COD (mg/l)	BOD (mg/l)	V
Sultan Tannery[a]	952	3087	930	30.19
UP Tannery[a]	2860	4956	1225	57.92
New Universal Tannery[a]	5982	7361	2460	114.54
Shewan Tannery[a]	1100	3500	2000	50.33
Super Tannery[a]	2780	4500	3000	85.8
Upper India Tannery[b]	2560	3800	1500	57.2

a = Vegetable tanning; b = Mixed tanning

Table 2. Chemical Analysis of Effluent Samples from Class `B' Tanneries

Tannery	SS (mg/l)	COD (mg/l)	BOD (mg/l)	V
Model Tannery[a]	4500	3028	1040	67.39
Javed Tannery[a]	2760	2600	1200	51.8
Kamal Tannery[a]	1500	3600	3100	72.87
Allied Tannery[a]	1360	5800	2700	69.2
Ideal Tannery[a]	2500	1100	3000	76.2

a = Vegetable tanning.

Table 3. Chemical Analysis of Effluent Samples from Class `C' Tanneries

Tannery	SS (mg/l)	COD (mg/l)	BOD (mg/l)	V
New Golden Tannery[a]	640	609	380	12.96
Globe Tannery[a]	1230	1130	640	24.23
Habib Tannery[b]	1630	536	460	24.04

a = Chrome tanning; b = Vegetable tanning.

From the above tables, it can be seen that the `V' values vary significantly within each class. For class A tanneries the `V' varies from 30.19 to 114.54, for class B and class C tanneries it varies from 51.8 to 76.2 and 12.96 to 24.23 respectively. Thus in cases where the effluent characteristics vary significantly within each class, any formulation based on average values might lead to considerable distortions in financial apportionment. A better alternative is to group the tanneries on the basis of their effluent characteristics (i.e. `V' values) rather than on the basis of hides processing capacity.

3. According to the Cheda et. al. formulation, in the dilution factor the weight of BOD and COD is half that of settleable matter in wastewater. In other words, the cost of removal of settleable matter is double that of BOD and COD abatement. However, this can not be said, a priori, without a proper cost analysis. Ideally, the relative cost of removal of each pollutant should be reflected in their weights.

5.4 An Alternative Formulation

In view of the above shortcomings in the present formulation, the 'dilution factor' equation has been modified to take into account the relative importance of different pollution parameters in terms of cost of treatment. This is specified as:

$$V = \left(\alpha \frac{A}{A_o} + \beta \frac{B}{B_o} + \gamma \frac{C}{C_o} + F \right) - 1$$

where, α = relative cost of removal of settleable matter in wastewater

β = relative cost of removal of BOD in wastewater

γ = relative cost of removal of COD in wastewater

The relative costs can be calculated by undertaking a cost analysis of the CETP. Once the 'V' is estimated, noxiousness degree, S, can be estimated using the dilution factor, V, different slabs.

Annual share of cost to each polluter is then calculated as:

$$C_i = \frac{S_i . Q_i . Z}{\sum_i S_i Q_i}$$

where, C_i = annualised cost apportioned to the ith tannery

S_i = noxiousness degree of the ith tannery

Q_i = annual wastewater flow of the ith tannery

Z = total annualised cost of joint wastewater collection and treatment system per unit flow.

For establishing the volume of effluent discharged to the wastewater collection system, water meter should be used. In addition, self reporting of discharges (both in terms of volume and pollution characteristics) by firms should be made mandatory. If firms fail to submit these statements, a presumptive value should be used for the amount of pollution generated by them. Any significant variation between the stated pollution and the actual amount of pollution (detected through random checks) should entail a penalty. Such firms should also be entered in a special list. Firms on such a list should be subject to a higher than average frequency of inspection.

ASSESSMENT AND SUGGESTIONS 6

Pollution is caused by both small-scale industry (SSIs) as well as medium/large-scale firms. The former, though small in scale of operation, are large in number such that the pollution from these SSIs constitute a considerable part of total industrial pollution. However, due to scarcity of resources the pollution control boards have focussed on medium and large scale firms in enforcing the environmental standards.

However, as noted earlier (Chapter 1), to deal with the pollution control in SSIs, CETPs have often been suggested and implemented. CETPs are cost effective both because of cost savings in joint treatment and lower costs of monitoring and enforcing the environmental standards.

6.1 Constraints

The success of any pollution control scheme depends on the effective monitoring of the environmental pollution and effective enforcement of legislation. In India, poor enforcement of environmental legislation (in frequent penalties and monitoring visits on part of the regulators) is largely responsible for a poor take off of the CETPs. As on 5.08.96, all the sanctions for CETPs have been made from an earlier $16 million line of credit granted by the World Bank way back in 1991. The $18 million available under the April 1995 line of credit lies entirely unutilised and uncommitted (TOI, Bombay, 5.8.96).

Several other factors are responsible for the slow start of the scheme. More important among them is the long delays in the clearance of the government grants. Since project papers pass through several agencies,

procedural formalities cause considerable delay. Delays are compounded because CETP proposals are often technically flawed.

In a weak enforcement regime, quite naturally the initiative for construction of CETP has come from different government bodies. In fact, in most of the cases, the CETPs are managed by various government bodies. However, so far as compliance of environmental standards are concerned, this type of public management of CETP creates a peculiar institutional problem. It is difficult for the concerned SPCB to come down heavily on another government agency for either non-compliance of standards or for any other matter.

Another important problem of the CETPs is the cost sharing arrangement among the CETP users. In India, the costs are shared mostly on the basis of production capacity, water consumes or volume of effluents. Important determinants like BOD and COD levels and SS levels of the effluent are ignored in the cost calculation. However, this system of charging does not give any incentive to the participating industries to use cleaner technologies. Under a charge system based on pollution load, the industries will have an incentive to upgrade their production technology, thereby improving upon their effluent quality and the consequent savings in their share of abatement costs.

Moreover, it is important to monitor the effluent quality regularly, if not for equitable cost sharing but atleast for the proper functioning of the CETP. Overstrength waste waters are reported to be a major factor responsible for the poor functioning of CETP in India.

6.2 Policy Prescriptions

- In the absence of a viable threat the SSIs cannot be expected to take the initiative for setting up CETP. While in the short run initiative will have to come from the government bodies, in the long efforts should be made to encourage industries to take initiatives for setting up CETPs. However, the management of the CETP should not be under any government body. It should be handed over to the respective industries association for operation and maintenance.

- In the recent years, several pollution generating units have been closed down by the court order. However, in most of the cases, these industries have appealed against the closure in the higher courts. While many of the cases are still pending in the higher court, these industries are operating as usual. The lengthy legal procedure provides a shield to the polluting firms. The need is to constitute an Environmental and Pollution Court to hasten the legal procedure.

- Single window clearance should be followed to expedite the whole process of clearance for CETPs.

- BOD, COD and SS levels as well as the volume of effluent should be taken into consideration for calculating the cost-share of the CETP facility users.

- The cost formulation should be simple so that the participating industries can verify their respective cost share.

- The participating industries should have the right to ask for an adjustment in cost share in which case they have to pay in advance the

fee for the purpose of recovering the cost for administration, field investigation, meter inspection as well as the fee for the chemical analyses of their wastewater.

- Where any industry is granted an adjustment, such adjustment shall be effective from the billing period after which such industry made application for such adjustment.

- Periodic revision of the charges with the built-in incentive and penalty scheme can induce pollution prevention and hence reduction in effluent generated at the existing level of output.

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REPORT ON
PEERS PROJECT:
IN THE FIELD OF
ENVIRONMENT AND ENTERPRISE

SUBMITTED TO

TERI, NEW DELHI

BY

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EXECUTIVE SUMMARY
REPORT ON PEERS PROJECT:
WORKSHOP ON ENVIRONMENT AND ENTERPRISE

By
Smita Premchander,
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I. The Objective of Joining PEERS Programme

The Programme on Energy, Environment and Resource Sustainability (PEERS): PEERS is a training programme conducted by TERI, Delhi, aimed at addressing the need for environmental consciousness among managers and policy-makers, and training them to introduce the environmental facet to the prism of their activities. The three-fold programme functions at a national and international scale and will help develop and promulgate concepts for Sustainable Development.

Phase I: It was a training programme conducted in New Delhi in Apr-May 1997 and Phase II consisted of a four week training period in North America in the later part of 1997.

Phase II: TERI organized four weeks of training in North America in late 1997. Participants were thus facilitated in developing a global view on issues of environment and sustainable development.

Phase III: The third phase of the programme consisted of lectures, individual study time, and project presentations by participants, in April 1998.

The author of the report joined the programme, as the head of a voluntary organization (VO), Sampark, Bangalore, with the objective of understanding:

- sustainability as a local and global issue
- dimensions of sustainability at a local level, and
- Possibilities of successfully implementing Eco-friendly Income Generating Programmes, along with VOs at the field level.

II. The Project

Sampark's project was to conduct a workshop on sustainable development and income generating projects for the rural poor, as this is Sampark's core area of work. The workshop was titled: Environment and Enterprise. The workshop concentrated on action-oriented and interactive learning, with the following objectives:

The change that was brought about in Sampark over the one year that I worked on the PEERS project, went far beyond the project alone. The programme has led to increased knowledge and exposure to the state of environment not only in India but also the rest of the world. It has helped me to commit myself strongly to the cause, and to commit resources of the organization as well.

Sampark has developed a framework within which to design development projects at field level. the theoritical framework has been shared at several national and international forums, and has been adopted by many VOs. It has been used by Sampark to design its development intervention.

IV. The Most Important Achievement: A Field Project

Sampark has designed the field project such that the three aims of gender equity, sustainability, and poverty eradication will be achieved together. Technologies and social and institutional changes will be introduced and brought about with the participation of people towards this objective.

Thus the field project seeks to work for:

- Increased awareness of people about macro level issues and alternatives;
- Increased awareness of external change agents, including government staff, researchers, policy makers, voluntary agencies on state of natural resources in villages;
- Increased support to VOs on alternative projects, technologies, and resources;

Sampark has done considerable networking for implementation of the framework mentioned above. Links with institutions visited in Phase 2 have been explored for:

* Capacity building of Sampark staff, and those of other VOs in the field of sustainable development;
* Exchange linkages for students and staff of academic institutions, for sustainable development projects;
* Development of new projects for research and technical support for sustainable natural resource management projects.

V. Summary of Achievements

In addition to the Workshop, described as conducted above, there were significant shifts in the understanding of the organization, on issues of sustainable development, and these are as follows:

1. First and foremost, the programmes helped to improve my understanding of, and skill

to develop, design programmes and projects for sustainable development, both in India and at international level.

2. Information and resource material on environmental issues was collected and updated at Sampark. A link was formed with TERI, and TERI publications acquired for the Resource Centre at Sampark, for access and use by Voluntary organizations.

3. Staff of Sampark were sensitized, trained and made aware of environmental dimensions of development work, and the perspective gained by me during the course of PEERS phase 1 and phase 2.

4. Sampark made links with resource persons in the field of environment management, who can be accessed for support to development programmes at field level

5. The Environment and Enterprise workshop improved conceptual and project design skills of 20 VO staff.

6. Sampark made links with VOs for further work in the field of environment friendly enterprise development.

7. Sampark made links with funding agencies who may be willing to support projects in the field of sustainable development.

8. As part of the field project described above, Sampark has developed a framework within which to design development projects at field level. The theoritical framework has been shared at several national and international forums, and has been adopted by many VOs. It has been used by Sampark to design its development intervention.

Sampark has designed the field project such that the three aims of gender equity, sustainability, and poverty eradication will be achieved together. Technologies and social and institutional changes will be introduced and brought about with the participation of people towards this objective.

IV. Commitments and Opportunities

The PEERS programme has led to increased knowledge, and exposure to the state of the environment not only in India but also the rest of the world. IT has helped me to commit myself strongly to the cause. As my commitment is first to poverty alleviation Linkages were made with Environmental Fund for NGOs, a Delhi based consultancy firm for funding to NGOs for environment based projects

The framework within which Sampark operates covers enterprise development, poverty alleviation, gender and sustainable natural resource management issues. We have made links with several organizations in the past few years to further these interests. As part of the PEERS programme, these links have been strengthened. There is a possibility of linking with more projects for research and implementation in the field of sustainable natural resource management, and we propose to do our best to develop these projects, so that delivery of development Programmes can be made environment friendly at the village level.

Finally, it would be appropriate to say that it is important to link policy with grassroots level action, so that policy is determined on the basis of grassroots issues, and at the grassroots level. people feel empowered to benefit from, and influence policies of the country. Sampark as a voluntary organization is committed to this linkage.

Smita Premchander
Secretary – Sampark
April, 98.

REPORT ON PEERS PROJECT:
WORKSHOP ON ENVIRONMENT AND ENTERPRISE

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REPORT ON PEERS PROJECT:
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By

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SAMPARK, BANGALORE

I. BACKGROUND OF PEERS PROJECT

PEERS (Programme on Energy, Environment and Resource Sustainability) is a training programme conducted by TERI, Delhi, aimed at addressing the need for environmental consciousness among managers and policy-makers. They are trained to introduce environmental issues in the realm of their decision making. The programme is conducted in three phases and functions at a national and international level. It helps to develop and promulgate concepts for Sustainable Development.

Phase I

This phase was conducted in New Delhi in April-May, 1997 by faculty who have done extensive work in the field of energy and environment.

Phase II

TERI organised four weeks of training weeks of training in North America in late 1997, preceded by one week in Norway. Participants were thus facilitated in developing a global view on issues of environment and sustainable development.

Phase III: The third phase of the programme consisted of lectures, individual study time, and project presentations by participants, in April 1998.

The author of the report joined the PEERS programme, as the head of SAMPARK, a voluntary organization (VO), with the objective of understanding the following:

- **sustainability as a local and global issue**
- **dimensions of sustainability at a local level, and**
- **possibilities of successfully implementing Eco-friendly Income Generating Programmes, along with VOs at the field level.**

II. BACKGROUND OF SAMPARK

Sampark is a voluntary agency, functioning from 1991. The range of its activities might be seen from the chart given below. Its mission is stated thus:

> ***`To expand capacities of vulnerable and poor people, especially women,***
> ***to improve their lives primarily through increasing***
> ***their income earning capacity***

Sampark's concerns for gender equity, people's participation, and environmentally sustainable development are built into all the programmes designed and executed by the organisation.

III. THE PROJECT: ENVIRONMENT AND ENTERPRISE WORKSHOP

SAMPARK conducted a workshop in connection with the PEERS project. This was a Training of Trainers programme where the idea was to introduce senior staff to environment friendly projects that could, perhaps, be promoted as enterprises at the village level.

A training programme on Sustainable Development and Income Generating Projects for the Rural Poor, was conceptualized, this being Sampark's core area of work.

1. The Workshop Context

There is a growing concern worldwide over the state of our environment. Our natural resources and the life they sustain are endangered. There is an urgent need to protect the existing natural resources in order to safeguard the interests of the coming generations.

Income generation in rural areas can be broadly classified under farm and non-farm activities. The concern among the rural populace, as in any other, is to improve existing standards of living. The demanding requirements of a growing nation add to this pressure. This leads to the commercialized and highly resource-oriented practice of rural professions: intensive farming practices, extensive use of fertilizers, encroachments into surrounding forests for farming and inhabitation, resultant soil erosion, water and land pollution, deforestation leading to near extinction of biodiversity, all of which add up to environmental degradation. All this, coupled with technology that promotes imperialism against nature, will lead to serious setbacks in the quality of our lives in the long run. Such a system subscribes to developmental activity that is ecologically unfriendly. and unsustainable.

Though traditional methods of work are considered to be environment- friendly, their market viability is questionable. Thus, the contradiction that seems to exist between market viability and Eco-friendliness lies at the root of Sampark's conception of the project.

Sampark has been working to promote income-generating enterprise in rural areas through NGOs. We recognize the pressure on rural populations and the need to identify and implement strategies, technologies and projects that lead to improved incomes in an environmentally sustainable manner.

The context of the workshop was therefore, to:

'Search for Income Generating Programmes that lead to viable businesses and are Environment-friendly.'

2. The Participants

In the process of designing our project, our target group of participants was classified as primary and secondary beneficiaries.

Primary beneficiaries: NGOs and other voluntary organizations from different districts in Karnataka were considered as a medium for collecting information and for information propagation. Staff of voluntary organizations were invited with a view to start up environment friendly enterprises in the field.

Secondary beneficiaries: The sustainable income generators in the farm and non-farm sectors of the rural areas and the general rural population.

Thus, our main target group was the NGOs and other voluntary organizations working in the rural sector, especially those promoting IGPs. However, persons from Governmental Organizations and corporate setups were also welcomed.

The programme was designed to accommodate 25-30 participants and selection was done on the following criteria:

- Preference for persons 25-40 years of age
- The person or organization had to be engaged in managing, planning or facilitating Income Generating or Environment related Programmes
- Nominees needed fluency in English, as this was the language of discussion and instruction.
- Lastly, acceptance of nominations was on a First-come, First-served, basis.

3. Objectives of the Workshop

At the field-level, a thorough understanding of the existing IGPs was required. Their degre of market viability and economic and ecological sustainability had to be ascertained. Th workshop was two-fold: the groups were exposed to internalize the concept of and need fo sustainability and SAMPARK was able to acquire information on existing rural practices

These groups served the purpose of:

- establishing contact with the rural area
- providing information on rural livelihoods, and
- the means by which there was dissemination of environmentally sustainable concepts.

The objectives of the workshop were to look at:

Workshop Objectives

- State of the Environment and Natural Resources
- Effect on the quality of life of the rural poor with whom voluntary organisations work
- Discussion and information on some potential Eco-friendly projects
- Exploration of ideas for possible environment friendly Income Generation Programmes

4. Topics covered

The workshop dealt with environment and enterprise issues in the rural areas. Accordingly the following topics were covered:

- State of Natural Resources, Environmental Issues in rural India and Sustainability
- Concept of Development and definition of Appropriate Technology
- List of Alternative Building Technologies
- Rural Energy Policy
- Renewable Energy Technologies for Rural areas
- Forest Resources Protection and Regeneration
- Forestry related Practical Projects for NGOs
- The Business Community and its link with Community Development Activity : India Business and Community Partnership Trust (IBCPT)
- Soils : Types, Degradation and Reclamation and Watershed development
- Concept of IGPs and Enterprise
- Strategic Planning
- Project Design and Proposal Preparation
- Feasibility Test for Projects proposed
- NGOs and their role in promoting and upholding Environmentally Sustainable activities

5. Methodology

The programme comprised of Lectures, Case Studies, Group Activities and Presentations, Open ended Discussions and a Field Visit. The participants were also provided with sufficient resource material in the form of extracts from magazines, environment related articles, research papers and literature on the discussed technologies. The contents provided a holistic picture of the state of our environment. They prepared the ground for exploration of the possibilities of taking up Eco-friendly and viable alternate technologies as enterprise or as IGPs. Information on supporting organizations as Technical Back-up Units or funders, was also included wherever possible.

Methodology

- Lectures
- Case Studies
- Group Discussion
- Presentations
- Open ended Discussions
- Field Visit.

6. Proceedings of the Workshop

a. Inauguration

The Workshop began at 9:45 am, on the 19th of August 1997. The Chief Guest was Mr. Srinivasan, Chief General manager, National Bank for Agriculture and Rural Development (NABARD), Bangalore. He spoke on the need for more such workshops through which the concept of sustainability in all areas could be propagated. He highlighted the misuse of inexpensive and easily accessible resources and listed several problems encountered due to people's ignorance or by their overlooking the environmental impacts of development.

The workshop was declared open with the lighting of the lamp by Mr. Srinivas, CGM, NABARD, Mrs. Smita Premchander, Secretary, Sampark and three participants from the workshop.

b. Sessions

DAY 1

The participants were briefed on the objectives of the workshop, provided with folders containing extracts from magazines, research papers on Eco-friendly technologies, case studies and other relevant articles for use during the workshop. The schedule and sessions for the following days of the workshop was discussed with the participants.

The first session for the day was State of Natural Resources, Environmental Issues in rural India and Sustainability, introduced by Mrs. Smita Premchander.

Statistics on the world's and India's share of natural resources were discussed. Reference was made to: the dynamism of the Indian population, the status of our resources and the effect on Gross Domestic Product and Industrial Product. Environmental impact, the concept of Carrying Capacity and gender issues in relation to management of natural resources. An OHP was used to facilitate clarity.

This foundation set, Mrs. Smita divided the participants into four groups, each representing a natural resource: Air, Water. Land and Forests. The groups were given the task of listing problems encountered in their areas and the possible solutions. This group discussion was followed by presentations by the participants.

Further to the discussions on natural resources, Mrs. Smita defined the concept of sustainability, sustainable living and sustainable development and through statistical data elucidated the correlation between Economy and Environmental Sustainability.

The afternoon session was conducted by Professor Jagadish, Department of Civil Engineering, Indian Institute of Science, on the Concept of Development and definition of Appropriate Technology. He also conducted the session on alternative building technologies.

The concept of appropriate technology, evolved about 25 years ago. It is based on a holistic outlook on material development and includes the human and societal impact involved in a civilization's march towards modernity.

This form of technology with regard to environment and social aspects promotes:

- Self-reliance
- Resource conservation
- Environmental soundness, and
- Participatory approach to change

He elucidated these aspects with several examples. He explained that the technological criteria for technology that is considered appropriate should:

- be preferential to capital savings (and not capital investments)
- be energy efficient or conservative
- use local material
- produce goods of mass consumption (and not luxury goods)
- base technologies on rational and sustained use of environment, and
- be managed in a decentralized fashion

In the session on building technologies, he listed those that conformed to the mentioned criteria.

- Stabilized mud blocks
- Lime cured mud blocks
- Ferro-concrete roofing tiles
- and, Alternate building technologies using fly ash and other pozzolana

The Professor began work on these technologies in the year 1976. Though the technologies were primarily introduced for use in the rural areas many urbanites also showed interest in it. Examples of these technologies in use in urban areas were shown with slides. These examples also showed that the technologies were not merely functional but could be aesthetically used to suit individual tastes.

Further discussions were on percentage compositions of the soil for making mud blocks, composition of ferro concrete tiles and their preparation and aspects of using fly ash, ground rice husk and other pozzolana based building material.

Day one of the workshop ended with a briefing to the participants on the next day's field visit and distribution of checklists with the information that the participants need to gather in the field visit.

DAY 2

The field visit was to two villages: Siddganahalli and Ungra. Prof. Jagadish and Dr. Venkatrama Reddy are the guides for the visit.

Our first stop was at Siddganahalli, which is about an hour and a half away from Bangalore. Here we visited an NGO - Gramvidya, established by Prof. Jagadish, which is working to promote the mud block technology for construction of houses in and around the village. The personnel at the NGO were involved in making Mud blocks. The participants were able to observe the mud mixture preparation, consistency required of the mixture when introduced to moisture, weighing of the mixture before its compaction, the process of compaction and the completed block. For the preparation of mud blocks the main property considered is soil density. The compaction machine applies 12 tonnes of force on the mud mixture. The blocks thus prepared are kept aside for drying. Prof. Jagadish explained the merits of using the mud block as against the conventional red oxide bricks. The entire process of mud block making did not require fuel, utilized man power of about six people for the whole process, incurred minimum costs for transportation, as raw material was abundantly available locally (within the NGO land) and required an initial input of Rs. 13,000 for the block-making machine. This apart, the fact that most soil varieties, with the exception of types like extremely clayey soils, can be used for mud block making, give it potential for wide usage.

The ongoing experiments on the mud block technology at Gramvidya were on different shapes of bricks for a variety of traditional and modern architectural designs, use of mud blocks for roofing using concrete or wooden panels and the heat reflection capacity of mud blocks used in roofing.

Inside one of the buildings in Gramvidya, Prof. Jagadish showed the participants an installed Improved Chulha and the method of using it. Since all vessels would not fit perfectly into the orifice for heating, there were fittings to the orifice provided which were of different holding-shapes and catered to all shapes of vessels in the rural areas. The more recent version, still in research, is a mosaic lined Improved Chulha, designed to contain heat more efficiently.

The next stop was about two and a half-hours from Siddaganahalli on the outskirts of the village Ungra. This is the Astra Extension office established by IISc in the year 1976. The village Ungra, has a community biogas plant which is presently non-functional due to political reasons.

The Astra Extension area covers fifty acres of land, green with flourishing vegetation. After lunch the participants were shown the area by Dr. Venkatrama Reddy. We were shown the bio-mass plant which works exclusively on fresh plant residues and leaf litter from the surroundings. All fuel and energy requirements of the Astra area were provided for by this unit.

Just beside the bio-mass plant was the steam curing kiln. As mentioned before most, but not all varieties of soil can be used for making mud blocks. Soils that contain a greater proportion of clay do not make good raw material for the blocks as clayey soils are known to be unstable and highly porous in nature. When these soils are subject to adverse conditions of rain or high temperatures, they tend to swell or crack respectively. The blocks prepared of these soils are piled into the steam curing unit and treated to lime in the presence of moisture at eighty degrees centigrade and hence are stabilized.

Behind the kiln and the bio mass plant were rows of freshly made ferro-concrete roof tiles of different shapes and sizes, placed next to their moulds. Dr. Reddy explained the constituents of the tiles and process of making the tiles. The use of the term "ferro" was due to the use of chicken mesh and J-wires in the concrete mixture. These constituents imparted the tiles with the property of extra strength to withstand overlying weight and heaviness such that they could not be easily lifted by monkeys, as was the problem with smaller and lighter tiles. Besides these tiles were much more energy efficient than the conventionally used and famous Mangalore tiles which utilized about 0.4 - 0.5 kg of fuel wood per tile.

We were shown around the buildings in the Astra Extension area. There were varieties of houses with variations in building material - stones, mud blocks, lime cured blocks, plastered and non-plastered walls, etc., in roofing styles - different structural designs in ferro concrete roofing tiles, cemented blocks and bricks with wooden or metal panels for support, etc., and architectural designs - traditional: with rooms around a courtyard with pillars, to modern compact houses.

After these sights, the groups assembled under a thatch roofed sit-out and discussed several issues related to the building technology in terms of an IGP and enterprise with Dr. Venkatrama Reddy and Prof. Jagadish, who also were more than willing to answer queries related to the technological aspects of the same.

DAY 3:

The third day of the programme began with a review of the past two days by the participants. Mr. Fidelis of OUTREACH (Hosur Project) gave an account of the events of day one, while Mr. Paramesh of Grasim Social Service Society listed the highlights of the second days field visit.
The first session for the day was on Rural Energy Policy, by Mrs. Soma Dutta of TERI, Delhi.

Features of the Rural Energy sector: The main features of the rural energy scenario in India is that there is an overwhelming dependence on biomass, mainly fuelwood, crop residues and animal dung, for domestic fuel. While there are several regional variations in the use pattern (depending on the availability and accessibility to biomass resources), biomass continues to be the main fuel across the country. Another significant feature of rural energy is that among the various energy consuming sector (agriculture, rural industries, and transport, domestic), the domestic sector accounts for nearly 75% of the energy consumed. With in the domestic sector, it is the end use of cooking which contributes to more than 90% of the energy used.

Environmental and social dimensions of rural energy use: This pattern of energy usage has several environmental and social dimensions. The primary issue is that of depletion of the natural resources of the country. Though no study has scientifically established a link between rural firewood use and forest depletion, it is expected to contribute to the shortage. Though estimates vary widely, the present level of fuelwood consumption is in the range of 200 Mt annually. On the supply side, it is estimated that the annual sustainable yield from various sources (forests, wastelands, farmlands, degraded lands, homesteads, etc.) is in the range of 86 Mt., indicating a shortage of over a 100 Mt every year. The total annual consumption of dung as fuel is in the range of 100 Mt, while the total annual dung production is around 200 Mt. The supply of dung is higher than the demand for it as domestic fuel. However, there is an opportunity cost involved in the use of dung as fuel: traditionally used as organic manure in the fields, its diversion from this means a loss of nutrients for the soil.

Another and perhaps the most serious impact of this high dependence on biomass for domestic fuel are that it has serious health and environmental effects on the users, especially women and children In rural areas, it is the women who are responsible for the collection of fuel wood. As wood is becoming more and more scarce, they are required to walk longer distances and expend more time and energy in fuelwood collection. Additionally, biomass burning in rural kitchens is a major cause of indoor air pollution and causes lung, eye and throat disorders among women and children. This level of pollution is heightened further in a scarcity situation, when people are forced to burn inferior fuels like weeds, shrubs, grasses, etc. in their kitchens.

Government initiatives in the rural energy sector: This pattern of energy usage and its impact on quality of life and the environment has been documented and understood by the policy makers and over the years, several interventions, in the form of government programmes have been made. The government programmes introduced so far can be divided into four main categories

- supply augmentation measures which aim at increasing the total availability of fuels (social afforestation, wasteland development programmes, etc.)
- fuel substitution, which aim at replacing a traditional fuel with another one (rural electrification, kerosene supply through the PDS)
- energy efficiency, which is targeted at increasing the efficiency of use of various fuels (improved cookstoves, agricultural pumpset retrofitting) and
- renewable energy technologies (biogas and solar cookers).

Impact of Rural Energy Interventions: The interventions in the rural sector have had a limited impact on the energy usage as a whole. Taking the case of the rural electrification programme, which is the largest rural energy programme today, it can be seen that after over thirty years of being in implementation, it has managed to reach only 30% of the rural households. Electricity even today continues to be predominantly urban fuel. In the rural areas, electricity even when available suffers from problems of supply like low voltages, erratic supply, pilferage and inadequacy.

Renewable rural technologies: (RETs) are being promoted in India for the past 15 years or so. Among the various RETs which are being promoted in the rural sector, biogas has traditionally been the most popular and also the largest in terms of funds allocated. The other programme which has had a wide reach is the improved cookstoves programme. Today about 2.5 million biogas plants and 23 million improved cookstoves have been installed throughout the country. Both these programmes are promoted as multi-model, multi-agency programmes, with government bodies, non-governmental agencies and individual entrepreneurs participating. In both these programmes incentives are given to the people (to promote the usage of these technologies) in the form of subsidies to the beneficiary and a range of other incentives like motivation fee, turnkey fee, service charges etc. to the implementing agencies. Presently the subsidy on biogas plants covers around 25-30% of the plant cost (depending on the distance, cost of raw material and transportation, etc.), while the rest has to be met by the beneficiary.

While RETs like biogas plants, have brought about significant improvements in the quality of life of users, the overall impact has been limited. In terms of potential realization, both biogas and improved cookstoves programmes have realised only about 20% of the total identified potential so far. Estimates also show that together these programmes save around 10% of fuel wood consumed in a year.

There are several factors, which have contributed to this small impact of RETs. Firstly, while RETs has been discussed widely for several years now the actual funds allocated to this sector have been small. For instance, between 1981 and 1992, the govt. expenditure on grid electricity was Rs.812 billion: Rs.335 billion on petroleum, and Rs.158.5 billion on coal. Compared to this, the investment in renewable energy was a meager Rs.11.55 billion.

An important institution barrier in the effective promotion and adoption of renewable has been the centralized, top-down approach adopted for programme planning and implementation. The physical targets are set at the central level and then transmitted down to the level of the implementing agency. As a result the targets are often independent of the actual requirements. Further, the rural people, who are the final users of the technology, have hardly any role in deciding the design and contents of these programmes. In fact the lack of peoples participation has been recognized as one of the major causes of programme failures.
This session was followed by Renewable Energy Technologies, conducted jointly by Mr. Srinivas of TERI, Bangalore and Mrs. Soma Dutta.

This session presented an overview of the various RETs, which are being used in India today. The main end uses which were discussed were: cooking, lighting, water pumping and electricity generation.

The technologies included the following:

- Biogas, for cooking and lighting
- Improved cooking stoves for cooking
- Biomass gasifiers for thermal applications and power generation
- Solar photovoltaic technology for lighting
- Solar thermal technology for water heating, drying of agricultural produce and cooking (solar cookers), and
- Wind energy for water lifting

The various aspects that were discussed for each of these technologies were:

- Basic principle and functioning of the technology
- Components of the system
- Cost (initial investments and operating costs
- Limitations of the technology

- Government provisions for the promotion of the technology (programmes, agencies involved in implementation, financial and fiscal incentives provided under various schemes etc.)
- Appropriateness and suitability of the technology for rural applications
- The role and potential for NGOs to participate in dissemination
- Examples of successful applications of RETs

On the whole, the participants were most interested in gasifiers, solar photovoltaics and wind energy technologies. According to the participants, biogas and improved cookstoves are well established technologies, which they are all familiar with. Some participating NGOs had some experience with solar PV technologies, but these devices had been utilized for demonstration projects and not for dissemination at the household level. There was a discussion on the household level applications of these, the cost involved and the repair and maintenance requirements.

In addition to the presentation and a general discussion on the various technologies, the participants were also given an exercise for system sizing of a PV lighting system. They were given a proforma and asked to design a for their own houses and also prepare an estimate of the cost of installation of the system.

In the post-lunch session, Dr. Yellappa Reddy (IFS), lectured on Forests: Protection and Regeneration and Forest related Income Generating Programmes that can be taken up by Voluntary or Non Governmental Organisations.

Dr. Reddy began by dividing the world into three zones based on the vegetation variety: Temperate, Tropical and Desert regions, and explained the distinct features of these three areas. He pointed to local instances and explained the rich biological diversity of our country.

Dr. Reddy spoke of the rampant deforestation and its effects on the biotic and abiotic features of the area. He cited statistics that showed that on an average ninety eight thousand metric tons of inorganic pesticides per annum were in use in agriculture and explained the bio-accumulatory effects of its use and the harm it causes the soil characteristics in the long run.

He spoke in favor of multiple cropping and condemned monoculture (planting a single species of a plant variety) as nature herself favored diversity. Monoculture, he explained, depletes the soil of the one nutrient that the species takes up most and over the years leads to soil incapacitation and eventual soil death.

On the topic of Regeneration and Protection, Dr. Reddy listed examples of plants that can regenerate easily, require minimum care during growth, are indigenous, useful and contribute to biodiversity.

There were several forestry based Income Generating Programmes that the people could start, e.g. growing plants for use in herbal medicine, plant-based non-chemical cosmetics, sustainable timber production, confectioneries, drinks and beverages made of plant extracts, etc.

The following sessions were brief half to onehour long sessions: The Business Community and its link with Community Development Activity by Mr. Purushottam Raj of India Business and Community Partnership Trust (IBCPT), Definition of Soils, Types, Degradation and Reclamation and Watershed development, by Mr. Negi, Deputy General Manager, NABARD.

Mr. Raj spoke on the need for inclusion of the Indian business community and the multinational Companies in Community development activities, by way of providing funds to voluntary organisations. It is on this principle that IBCPT functions and could be called a "Match-Maker" between the corporate sector and the NGOs. He listed the criteria taken into consideration for the process of "Match-Making" and defined the possible areas of partnership between the institutions.

Mr. Negi of NABARD, defined soil as a three dimensional body, with life in the form of microorganisms and a medium for all plant growth. All soils have a characteristic feature, stratification and age. The character of soil depends on the inorganic, organic and biological aspects. All soils evolve from a parent rock and as they form, different layers arise, with the outermost being the most mature and fertile. The top-soil comprises not only of the fertile layer, but also of the leaf litter and other organic residues that fall on the ground. Thus the degree of stratification of soil determines its age.

It takes several decades for one inch of the soil layer to be formed but less than a few hours for it to be eroded. Degradation is not merely by erosion but also due to intensive farming practices, multiple applications of inorganic fertilizers, deforestation, quarrying, mining, leaching of waste dumps and land-fills, etc. As soil fertility is determined by is productivity it, thus, becomes very necessary for its sustained development and conservative use of the soil resource.

Mr. Negi spoke briefly on the processes of Composting and Vermicomposting and Organic fertilizers, and the use of watershed technology for reducing erosion and in water conservation.
This was the last session for the third day of the workshop.

DAY 4

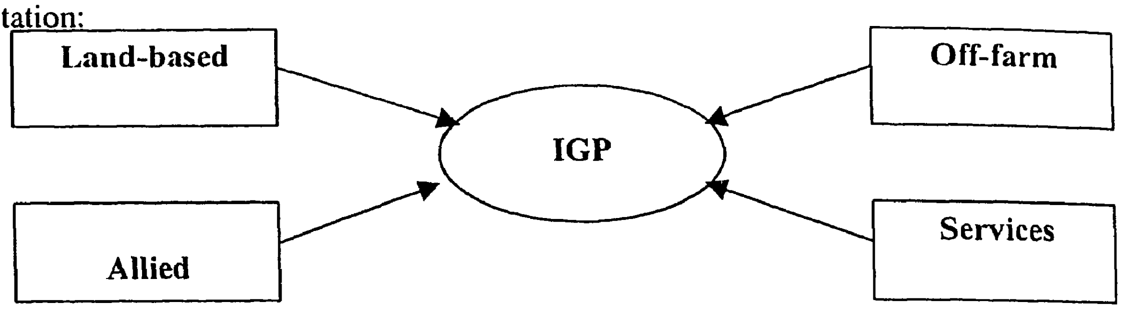
The fourth day of the Workshop began with a participant, Mr. Shivappa of MYRADA/PLAN, H. D. Kote Project, giving a synopsis of the third day's events.

The participants were asked to list, of the technologies discussed in the four days, which would be appropriate when taken up as enterprise in their project territories. Three projects were highlighted and accordingly, three groups were formed, each taking up one of the listed technologies for discussion and preparation of action plan after the day's sessions.
Session one for the day was on Concept of Income Generating Programmes and Enterprise and Strategic Planning, conducted by Mrs. Smita Premchander, Secretary, Sampark.

The critical questions that needed to be answered before venturing into any IGP were:

- what the goal of the implementing organisation is?
- what IGP is to be undertaken to achieve the goal? and
- what the definition of success is in relation to the goal?

The types of IGPs that could be taken up can be broadly classified as shown in the schematic representation:

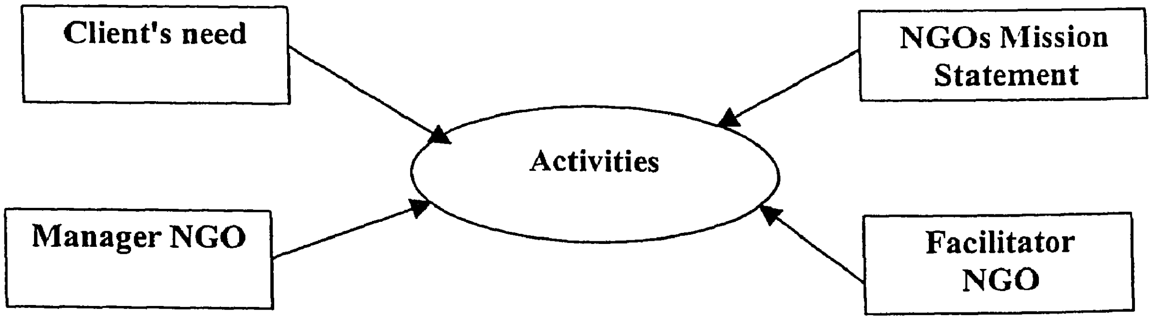


Whatever be the IGP, the implementing organisation would need to prioritize and internalise its set objectives.

The NGOs have the option of either merely providing support or implement a variety of programmes within an area or region or one type of programme in several regions or be a project based NGO, living on a project-to-project basis, or for one parameter, conduct several types of programmes. These options could be defined under the degrees of freedom of the NGO.

Once the option has been made, the NGO needs to identify its target group or beneficiaries, mobilize the target group and provide appropriate inputs as training, financial support or technical support, etc. The success of the programme conducted by the organisation will be a consequence of its analysis of the field situation, planning and implementation strategy, scale of the project, inputs, environmental factors (in the case of an environment related venture), whether appropriate market-matching is done, etc.

In the session on Strategic Planning, the participants were spoken to about the preliminary steps in any developmental activity. The first step being the setting of the organisation's philosophy or Mission Statement. Second, deriving its activities based on the target groups needs and the NGOs philosophy.



Once the activities are defined, the NGO could either undertake these activities as a Manager NGO or as a Facilitator NGO. In lay terms, the Manager NGO would "do", while the Facilitator NGO would "help do".

The session on Enterprise, covered the issues of Motivation, Idea generation, Narrowing down to workable ideas, Listing of constraints in the implementation of the workable ideas, Conducting feasibility tests on the selected project and depending on the results of the feasibility studies either peruse the project or retrace workable ideas.

After tea, Mr. Santhanam, District Development Manager, NABARD, gave a brief speech on the evolution of the Bank. Previously, Reserve Bank of India had an Agriculture Department as per the RBI Act for 1934, which catered to the financial needs of the rural sector. It was after the Parli Act of 1981, that National bank for Agricultural and Rural Development - NABARD emerged. NABARD provides financial support not only to agro-based activities, but also for non-farm and integrated rural development activities. Mr. Santhanam also explained the activities of NABARD form the time of its formation, the different types of loans available, the loan limits and the mode of loan sanctioning.

The following session on project Design and Proposal Planning was conducted by Mrs. Soma Dutta.

Since the Workshop was organised to discuss issues on Enterprise in relation to Environment, it was thought appropriate to deal with regard to Enterprise. Mr. Ravi (CA), Manager, Sampark, conducted a session with the participants on Feasibility and Viability of such an Enterprise.

The session began with the speaker introducing the concept of profit motive for the sustainability of any commercial venture. They were informed that the project report should aim at indicating that the project is viable which is inferred from the parameters emerging from different statements of the report.

It was highlighted that the report is normally divided into two parts. The first part dealing with theoretical aspects and the second part dealing with various financial statements to determine the financial viability of the project. As part of the theoretical aspects of the report the following areas were covered:

- Introduction to the Project
- Background of the Promoter or Entrepreneur
- Location of the Project
- Particulars of the Building and its Suitability
- Investment in Plant and Machinery
- Potential to Employ Labour
- Availability of Raw Material
- Manufacturing and Production process

- Availability of Power and other Utilities
- Eco-friendly Nature of the Project
- Conclusion to Establish the Technical and Market Feasibility of the Project

As part of the financial requirements of the report, the following aspects were explained to the participants:

- Cost of the Project and Means of Finance
- Repayment of Term-Loan and Interest Utilization
- Requirement of Working Capital for the Project
- Man power requirements and its Cost
- Administrative Expenses and other Overheads
- Depreciation
- Potential Profitability and Best Service Coverage ratio of the Project
- Project Cash Flow Statement
- Projected Balance Sheet

In this session the participants were also exposed to the commercial and financial aspects of an Enterprise.

Given the background on the art of Proposal making, the participants split into the three groups and were given an hour for the preparation of Project proposals for the Enterprise they selected.

After tea the participants presented with transparencies their groups action plans with the method in which they would approach their enterprise, keeping in mind the sessions on Concept of IGPs and Enterprise, Strategic Planning, Project Design and Proposal Preparation and Feasibility Test for Projects proposed. The participants also listed the areas where Sampark could help them in the process of venturing into such IGPs or Enterprise.

The last session for the day was an informal lecture and discussion on the important role that NGO participants could play in promulgating the learnings of the four days of the workshop, in their territories of work. The participants were given addresses of resource persons and support organisations.

The Valedictory ceremony, with the distribution of Participation Certificates by Mr. Ravi, Manager, Sampark, marked the conclusion of the eventful four-day Workshop.

c. Feedback From Participants

- The workshop was useful. - many of the topics covered had the possibility of practical application.

- Information relating to forestry, Eco-friendly projects (mud blocks, bio mass bio- gas, low cost housing etc.) and preparation of environment friendly project proposals would be very helpful..
- Some the rural based technologies discussed could be implemented in certain areas but more detail sand training in this regard were required.
- There is a to explore and understand these and other issues relating to the environment for the sustainable development. The areas where inputs were required were :project formulation, low cost housing, micro enterprise, forestry, mud blocks and roofing technologies.
- Participants have requested Sampark to provide support in the following ways :

* **Industry specific training:** Village level beneficiaries and staff of voluntary organizations are given training in the use of specific technologies to produce items such as mud blocks, ferro cement roofing tiles and sheets.

* **Action plans and project reports:** Voluntary organizations have requested help from Sampark to prepare project proposals, this time around, location and people specific, for some of the technologies and projects they have identified as suitable for their field areas. This would call for visits by Sampark's staff to the field to provide counselling and support till the project is started.

* **Compendium on environment friendly projects:** Even though there is a major emphasis on environmental issues, there is no proper information (on various environment friendly projects and details to prepare the project plan) accessible to the people. Voluntary organisations have requested Sampark to provide details of different types of environment-friendly projects to plan out strategies.

d. Suggestions for Future Programmes

This Workshop acted as a forerunner to future Programmes related to topics on the Environment and Enterprise. Based on participants' feedback and Sampark team's debriefing discussions, some aspects that seriously need to be considered for future workshops are :

- ☐ Specialization of the programme, in terms of topics : For instance, we may do programmes specifically on air related technologies, building technologies, soil and water technologies, etc.
- ☐ Regionalization of workshops: Training could be given at the district level, thereby making it possible for small voluntary organizations to attend, and for field visits to the project area.

❑ Making the distinction between Enterprise and Income Generating activities. Voluntary organizations clearly.prefer initiating the short-term income generation activities to the more involved enterprise development programmes. An income generation activity yields instant returns through production or trading but enterprise development refers to the process of understanding a business climate, developing skills, creating linkages and selling which are essential to sound business activity.

❑ Our own understanding of the workshop was that the concept of enterprise was new to NGOs and other Voluntary Organisations and therefore most seemed in favour of taking up the discussed technologies as an IGP rather than as an enterprise. There is a mental orientation towards welfare activities rather than micro enterprise promotion, which needs to be tackled first.

❑ Familiarization : Participant NGOs were to be briefed on aspects of business and enterprise and the related management and organisational aspects.

❑ Identification of two target groups for the programme - one, enterprise oriented which would cater to entrepreneurs, and the other IGP oriented, which would cater to NGOs and such service oriented organisations. Thus specific and required inputs could be provided based on the needs of the target group.

A larger numbers of participants could be invited and the programme conducted for a longer duration of time, for a week or ten days. Sufficient funding should be raised for such programmes, so that field visits, visits to demonstration sites may be arranged.

Parallel sessions on different issues could be conducted and participants provided with the option of selecting the sessions that they would like to attend.

One or two daylong workshops could be arranged separately, with in-depth view of one specific technology, inclusive of a field visit and successful case studies of the technology in question.

IV. Field level programmes for gender and natural resource management

Sampark's experience and understanding of issues pertaining to gender, environment and enterprise has been incorporated in the designing of programmes to develop women's leadership and initiating poverty alleviation activities, which are also environmentally sustainable.

Several villages have already been chosen for this work. The section below provides some insight as to the measures employed for their selection.

a. Project Area Selection

As part of Sampark's mandate to initiate a field project on *Sustainable Natural Resources Management* the first steps towards identifying suitable communities were taken in January and February 1998.

To this end, nine villages were identified with the assistance of Samuha, a voluntary organisation based in Raichur district with outreach teams in the Koppal area of southwestern Raichur. All of them are located in the semi-arid zone, beyond the reach of the Tungabhadra Irrigation project. In general, these villages are amongst the poorest in the district, and dryland agriculture, pastoral activity and daily-wage labour from work on government and private projects dominate the livelihood scenario.

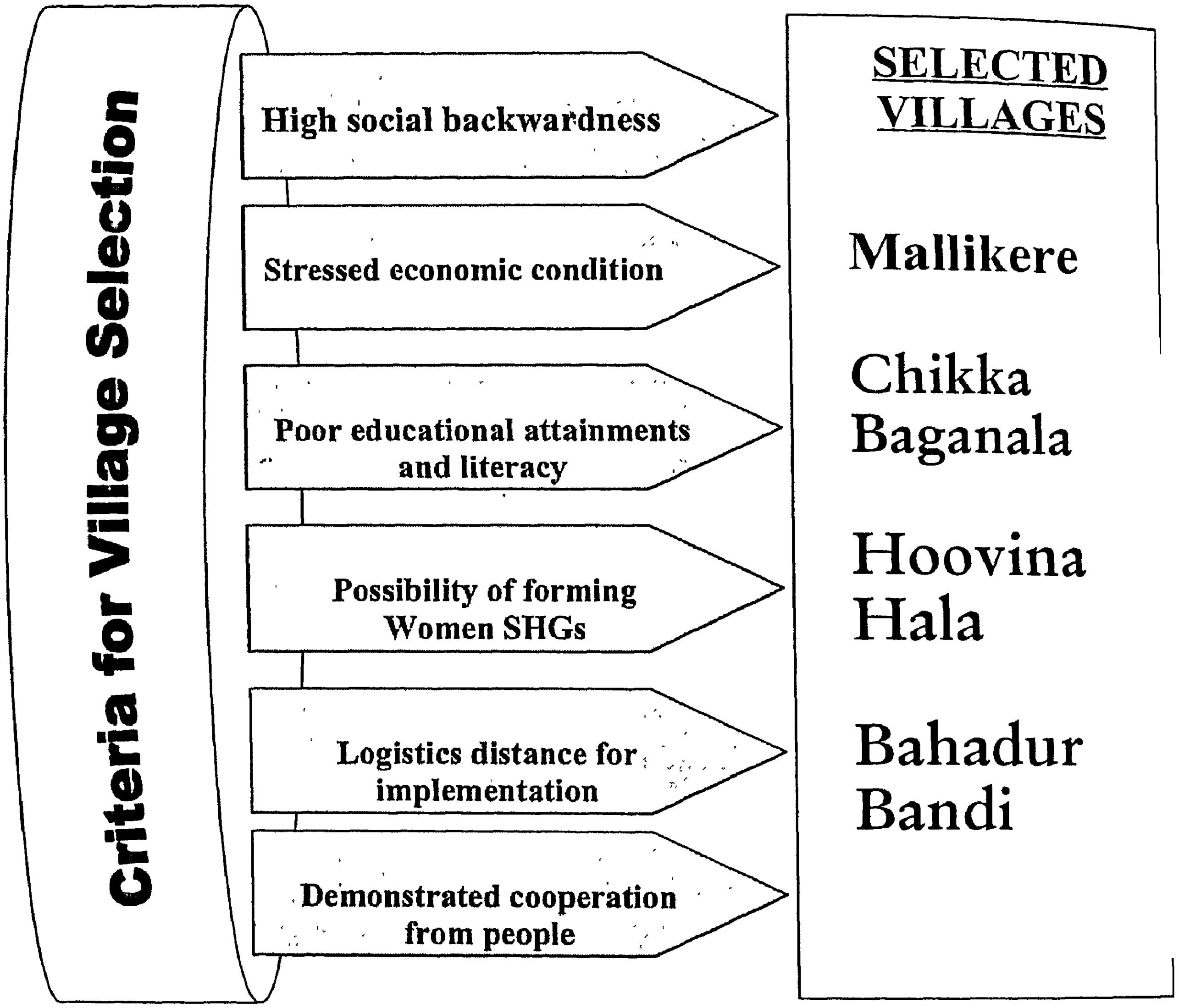
Villages

1. Bahadur Bandi.
2. Hoovinahalli
3. B.Hosahalli
4. Hyati
5. Mallikeri
6. Lachenakeri
7. Chikka Baganala
8. Mundaragi
9. Karkihalli

b. Criteria for selection of villages

Villages where women's self help groups would be formed were selected based on certain criteria. These SHGs would become the focus of activities during the study:

The villages were ranked in descending order, based upon the data collected for each of the criteria:


Criteria for Village Selection
High social backwardness
Stressed economic condition
Poor educational attainments and literacy
Possibility of forming Women SHGs
Logistics distance for implementation
Demonstrated cooperation from people
SELECTED VILLAGES
Mallikere
Chikka Baganala
Hoovina Hala
Bahadur Bandi

c. Methodology used for selecting the villages:

The Sampark team met government teachers, local opinion leaders, Panchayat members, youth and women of all the nine villages to familiarize themselves with the set-up. Sampark's objectives and the purpose of the study were explained to them. The meetings succeeded in getting the communities quite interested in the study, and they reached the consensus that this was probably required at this stage.

Data about population, socio-economic conditions, education, living conditions, land patterns, etc. were collected during subsequent visits. A combination of participatory tools and secondary data yielded this. The main methods used to collect information were: Social mapping, Group discussions, House visits and personal discussions with officials of the Taluk office, Panchayats, Revenue department and the Women and Child Development Department.

d. Major Findings

A summary of the major findings is given below:

Population

The male-female population ratio is 1.04:1, which is comparable with the national average. Community-wise break-up of the population in these villages is given below:

Sl. No.	Name of the Village	Total Houses	Popula - tion	SC	ST	Other	Dominant caste	Ranks
1.	Bahadur Bandi	220	2028	144	86	1798	Muslim & Kurubas	5
2	Hoovinahalla	89	523	164	-	359	Kurubas	4
3.	B.Hosahalli	220	1365	167	49	1149	Kurubas	6
4.	Hyati	223	1474	203	117	1154	Lingayats & Reddy	7
5.	Mallikere	53	307	117	-	190	SC	2
6.	Mundaragi	150	900	180	310	410	SC & ST	1
7.	C.Baganala	113	796	175	110	511	SC	3
8.	Karihalli	210	1426	293	83	1050	Kurubas	5

Castes and Social Practices

Scheduled Castes, Scheduled Tribes and Kurubas are the dominant castes in all the villages under study. However, Reddys and Lingayats exercise control over village institutions.

Untouchability and child marriage still exists. . The 'Devadasi system' wherein young girls are dedicated to serve in temples is also prevalent. This system has been abused over the years and the girls are now viewed in a negative light by society. Some of them have now been rehabilitated under government schemes. The dowry system prevails in all the villages. Dowries may be offered in cash and kind -through gifts of cows and land.

Alcoholism, bonded labour and money lending also observed. Talawar and Dalapathi, who are from the upper castes, control village-level credit.

Urus, Ugadhi, Ganesh Chaturthi, Deepavali and Ramzan are common festivals celebrated by the people.

Land Holdings

In all the villages, a majority of the people are marginal farmers or landless. Few people have more than 10 acres of land.

Sl. No.	Name of the Village	Land less	1-4 acres Margin. Farmers	5-10 acres Small farmers	More than 10 acres	Rank
1.	**Bahadur Bandi**	**32%**	**47%**	**17%**	**3.18%**	**5**
2.	**Hoovinahalla**	**26.96%**	**62.92%**	**12.35%**	**2.24%**	**2**
3.	**B.Hosahalli**	**35.45%**	**49.54%**	**12.72%**	**2.27%**	**2**
4.	**Mallikere**	**32.07%**	**52.83%**	**11.32%**	**3.77%**	**2**
5.	**Hyati**	**16.59%**	**65.02%**	**9.41%**	**8.96%**	**4**
6.	**C.Baganala**	**31.81%**	**51.32%**	**14.54%**	**3.53%**	**1**
7.	**Karihalli**	**21.90%**	**64.28%**	**10.47%**	**3.35%**	**1**
8.	**Lachinakere**	**15.90%**	**60.24%**	**20.18%**	**3.66%**	**6**
9.	**Mundaragi**	**49.33%**	**37.33%**	**8.66%**	**4.66%**	**1**

Education

Most of the people are uneducated and few of them finished primary level education. Compared to men, the literacy level of women is very low. Hardly any have gone on to higher education.

S.NO.	NAME OF THE VILLAGE	LITERATE MEN	LITERATE WOMEN	SSLC	PUC	DEGREE	RANKS
1.	Bahadur Bandi	489	121	50	2TCH	6	6
2	Hoovinahalla	149	61	15	-	2	7
3.	B.Hosahalli	287	90	20	-	5 Men 2 Fem.	5
4.	Hyati	305	82	20	-	10	4
5.	Mallikere	45	6	5 Men 1 Fem.	1	1	2
6.	Mundaragi	-	-	5	3	1B.Ed	
7.	C.Baganala	110	14	20	-	2	1
8.	Karihalli	218	35	5	-	4	3

Educational opportunities

Every village has schools at the primary (Std. 1-4) and secondary (Std. 5-7) levels. Hyati has the distinction of a high school. Most girl children discontinue their education after the primary level because of poverty. In the protective atmosphere of these villages, poor transport facilities are also an obstacle to them pursuing educational qualifications.

Agriculture

Rained agriculture is the primary occupation, and engages the villagers in the 4 or 5 months of the year when it rains. A few lift irrigation sets are available.

The daily wage rates for men vary from Rs 20 to 25 per day and for women from Rs 15 to 20 per day.

The major crops grown are jowar (sorghum), groundnut, sajje, Navanee (minor millets), sunflower, seasamum, and horse gram. Those farmers who have access to water grow paddy.

Sl. No.	Name of the Village	Waste Land	Dry land	Wetland	Total Geographical area	Ranks
1.	Bahadur Bandi	14.6%	83.9%	-	1951.65	1
2	Hoovinahalla	8.29%	91.42%		1414.74	3
3.	B.Hosahalli	17.68%	81.67%		979.61	2
4.	Hyati	64.87%	17.31%	16.66%	4801.82	6
5.	Mallikere	21.52%	55.68%	21.88%	1364.61	7
6.	C.Baganala	74.75%	17.08%	6.47%	3090.33	5
7.	Karihalli	90.52%	6.53%	2.25%	11496.3	4
8.	Mundaragi					

Animals

Cows, buffaloes, bulls, and oxen are kept to support agricultural activity. Some farmers maintain poultry, pigs and sheep to supplement their income.

Housing

90% of the residents live in huts and mud houses; a few people have concrete houses. Each village has 10 to 15 "janatha" (low-cost) houses provided by government under the Ashraya scheme.

Common diseases

Tuberculosis, jaundice, cholera and diarrhea are common. Some children have skin diseases. There are a few cases of leprosy. There are a significant number of physically handicapped persons.

Village institutions

Only Karkihalli has a Primary Health Centre. None of these villages has a bank: the nearest banks are in Koppal. . Apart from the only high school, Hyati also has a Post office and a Ration Shop. Hoovinahalli has phone facilities. B. Hosahalli, Hyati, Chikka Baganala and Karkihalli have Youth Associations.

Government Programmes

Government schemes such as DWACRA, IRDP, Housing, Borewells, and lift-irrigation are available in all villages. A scheme specific to this area is the Ganga Kalyani Yojane, by which Devadasis are offered 1 to 2 acres of land to cultivate if they change their vocation. Bhagya Jyothi, for widows and old age pension schemes are the other programmes which are operating in the villages chosen for our consideration.

Status of Women

Women take a back seat in the decision-making of the community. The elected women panchayat members merely act at the behest of their men folk, and are not active during discussions in the panchayat. In general, it is noticeable that women's health is a neglected area.

Politics

There is widespread awareness of politics, politicians and parties. However, the community leaders usually govern voting patterns and determine who will get their community's votes.

Problems outlined

The concerns were listed in box are the most pressing in these villages:

Problems outlined

- **Lack of regular employment**
- **Poor water facilities - for drinking and for agriculture**
- **Poor health care facilities**
- **Inadequate bus and transport facilities**
- **Lack of a drainage system for waste water**
- **Prevalence of child marriages**
- **No ration shops**
- **No toilets**
- **Prevalence of the dowry system**
- **Girl children are neglected by parents - no proper education**
- **Alcoholism**
- **No veterinary hospital**
- **Casteism**
- **Poor housing - 90% of the people live in huts**
- **No ration cards, so unable to access government subsidised grains**

Name of the Village	Social Back-wardness	Edu-cat-ion	Land Patt-ern	Land Hold-ing	Wom en SHG	Ease of reach	Co-operatio n from people	Score	Ranks
Bahadur Bandi	5	6	1	5	2	1	2	22	4
Hoovinahalla	4	7	3	2	2	1	2	21	3
B.Hosahalli	6	5	2	2	5	1	5	26	7
Hyati	7	4	6	4	1	2	1	25	6
Mallikere	2	2	7	2	1	2	1	17	1
Mundaragi	1			1	5	3	5		-
C.Baganala	3	1	5	1	3	4	3	20	2
Karihalli	5	3	4	1	4	5	4	25	6

On the basis of the above ranking the following villages were chosen for further activity in this study:
Mallikere, Chikka Baganala, Hoovinahalli, Bahadur Bandi.

SAMPARK will establish a field office with two women staff members, who will stay permanently on the project. Two others, visiting every week from Bangalore will be responsible for the training and documentation and will mobilise external support for the project.

It is expected that once the women's SHG groups are formed sustainable development activity will take place over the next few years. The women will be given leadership and group organization inputs by Sampark. Community forums will then be constituted with a gender balance, and these will address community issues. Poverty alleviation programmes will be started, with environment

IV. ACHIEVEMENT OF THE PROGRAMME AND THE PROJECTS

First and foremost, the PEERS training helped to improve my understanding of, and skill to develop and design Programmes, practices and policies for sustainable development, both in India and at the global level. As part of the project, it helped Sampark to design and disseminates information in this field, to the voluntary sector . Sampark could also provide rural projects with exposure and link them to suitable technologies which promote sustainable development. Over the past one year, the efforts has Sampark has made are as follows

1. Environment and enterprise workshop

- Developed an understanding of and collated information on environmental issues;
- Made links with resource persons in the field of environment management, who can be accessed for support
- Staff of Sampark have been sensitized and made aware of environmental dimensions of development work
- Trained 20 participants on environment and enterprise
- Made links with voluntary agencies for further work in the area of environment and enterprise.

2. Fund raising for environment sustainable projects

Sampark has explored various sources of funding for environment friendly projects. It has raised three and a half lakhs for the training as well as for the field project taken up in Raichur district of Karnataka. Project proposals for training and follow-up programmes for Eco- friendly income generation projects and solid waste management and income generation for women. have been submitted to organisations based in India. .

3. Linkages with international organizations

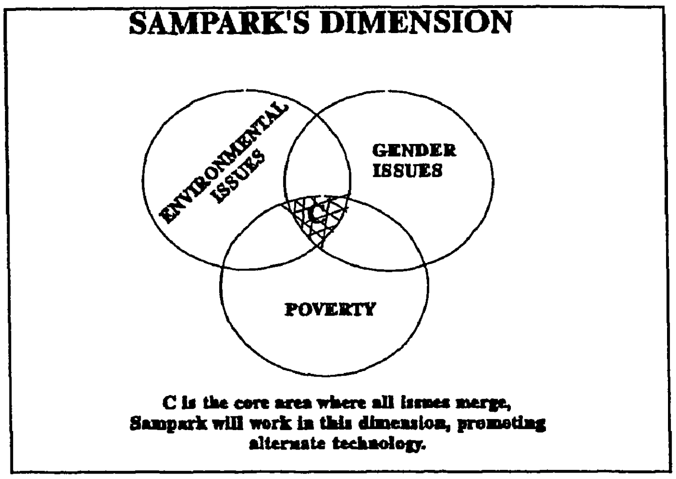
Links established with several organizations in Norway, Canada and USA during PEERS Phase 2 enabled SAMPARK to explore the possibilities of raising funds for environment projects and of obtaining information on environmental issues.

4. Field project in Gender, Enterprise and Environment

Sampark has designed the field project such that the three aims of gender equity, sustainability, and poverty eradication will be achieved together. Technologies and social and institutional changes will be introduced and brought about with the participation of people towards this objective.

V. PROPOSED FOLLOW-UP ACTIVITIES

Sampark 'a approach to development combines sustainability issues with poverty eradication and gender equity.


SAMPARK'S DIMENSION

C is the core area where all issues merge, Sampark will work in this dimension, promoting alternate technology.

With this approach, we will continue the following activities in the future.

a. Training

Keeping in mind the feedback received from the participants. Sampark intends to conduct more training workshops pertaining to enterprise and environment in the future. During informal discussions with the participants, we gathered that most were interested in exploring the aspects of the technologies discussed either as an IGP or as Enterprise. Once they venture into the field of Eco-friendly technologies, there will be some distinct areas where they will require Sampark's support. Conducting more training programmes on specific technologies and conceptual topics, exposure to new Eco-friendly technologies in the form of case-studies and field-visits, furnishing details on enterprise planning and financial management techniques are some of the techniques which may be used...

Enterprise Planning and Financial Management: As part of the other activities, Sampark's counselling cell regularly conducts training programmes in Bangalore and outside as well. The areas are Idea Generation and Enterprise and conceptual and technical skills for the same are also promoted. We could thus cater to the participants' need for enterprise planning and financial management.

Marketing Training: Marketing has been one of the core areas of our work, and from Sampark's birth the department has worked towards providing rural artisans and their handicrafts the exposure they deserve in the urban set up. We are open to conducting training programmes on Marketing Strategies for NGOs and entrepreneurs who take up Eco-friendly income generation as an IGP or enterprise and equip them to market their products.

b. Dissemination of Information on Environment Related Issues

Sampark has a well-equipped reference centre and research team and would be willing to provide the participants with material on Eco-friendly technologies and other related aspects as and when we come across such information. . Workshop participants have been requested to keep in touch with Sampark, as they can contribute to the collection of environment related information. These articles can be carried in our **newsletters**, AGENDAS and VIEWS and mailed to the Workshop participants and others.

c. Compendium on environment friendly projects

As voluntary organisations have expressed the need for information on various environment friendly projects and details to prepare project plans. Sampark will collect information on these aspects and compiles a compendium.

d. Field Programme on Sustainable natural resource management in dry regions of Raichur district.

Sampark will continue its direct involvement of addressing the key issues in this region. It is expected that in these villages, groups of women will be organized, with a view to sustainable development over the next few years. The women will be given leadership and group organization inputs by Sampark. Community forums will then be constituted with a gender balance, and these will address community issues. Poverty alleviation programmes with environment friendly income generating options for both farm and non-farm sectors will be introduced.

e. Fund raising for environment sustainable projects

Sampark will expand its linkages with funding organisations and explore the possibilities of mobilizing funds for continuity in the activities planned for the future. Sampark also will support other voluntary organizations in their efforts to raise funds for environment friendly projects after they undergo the training by Sampark.

f. Sustainable development by using new technology

- Putting Sampark's research and project experiences on the internet
- Usage of internet for research, development and at least information on possible fundraising for development organizations
- Usage of Internet to explore alternate technologies.

- Technologies for which leads were available: solar drying of mangoes, which can be started as a village enterprise

- There are institutions doing similar research that Sampark does, especially participatory evaluation of development projects, and it would be worthwhile to get in touch with them to share project reports.

- The information and technology division, its management and organization, and the way in which it services IISD were a great learning experience. All funded projects are put on the Internet. The information services people put in simple templates so that researchers can continuously update information put up about their projects. Project people own the sites.

- It would be worthwhile to send someone from Sampark for training in the information and services department of IISD, if such a linkage can be made possible as a student attachment.

VII. CONCLUSION

The PEERS programme has led to an increased knowledge and exposure to the state of the environment not only in India but also the rest of the world. It has helped me to commit myself strongly to the cause. Linkages were made with Environmental Fund for NGOs; a Delhi based consultancy firm for funding to NGOs for environment based projects

The framework within which Sampark operates covers enterprise development, poverty alleviation, gender and sustainable natural resource management issues. We have made links with several organizations in the past few years to further these interests. As part of the PEERS programme, these links have been strengthened. There is a possibility of linking with more projects for research and implementation in the field of sustainable natural resource management, and we propose to do our best to develop these projects, so that delivery of development Programmes can be made environment friendly at the village level.

As head of the organisation, my effort will be to continue to find projects which are both environment- friendly, and which will augment incomes of rural poor.

Smita Premchander
Secretary – Sampark
April, 98.

List of Annexures

1. Programme Brochure
2. Programme Schedule
3. List of Participants
4. List of Resource persons
5. Photographic Plates

Annexure 1

Programme Brochure

The programme will accommodate 25 - 30 participants. They will be selected on the basis of the following criteria :

- Preferably in the age group of 25 - 40 years.
- Engaged in managing, planning or facilitating Income Generating Programmes or Environment related issues.
- The course will be conducted in English, hence the person nominated should have the ability to understand, read and write English.
- The selection of candidates would be on 'First - come, First - serve' basis.

ACCOMMODATION AND FEES

Candidates are given the choice of either availing the lodging offered or making their own arrangements for the four day long workshop.

The fees, inclusive of accommodation, = 950/-
The fees, exclusive of accommodation, = 450/-

Both being non-refundable. The fee amount is required to be sent along with the nomination form. Please note only applications accompanied by registration fee will be accepted for the programme.

NGOs and their sponsor organizations may also decide to provide out of pocket expenses to their norms, as there is no such provision in the training programme.

DURATION AND DATES

The workshop will be of four days duration, commencing on the 19th of August, 1997, at 10:00 am, and will conclude on the 22nd of August, 1997. Participants are requested to arrive and register at the venue on the previous evening on the 18th of August, 1997, in any case not later than 9am on the morning of 19th August, 1997.

WORKSHOP ON
ENVIRONMENT AND ENTERPRISE

Date: 19 - 22, August 1997

Venue: ASHIRWAD, 30 St.Marks
Road, Bangalore - 560 001.

Phone: 2210154

Conducted by
SAMPARK, Bangalore.

INTRODUCTION

There is a growing concern world wide over the state of the environment. Our Natural Resources, Air, Water, Land and *the life they sustain* are all endangered of their quality and kind. The need of the hour is to sustain the existing natural resources to safeguard the interests of the coming generations.

The areas that *intimately* work with the wilderness are the villages and these are the very areas that are on the verge of alienation with nature. There are intensive farming practices, extensive use of chemical fertilizers, encroachments into surrounding *forests for farming and inhabitation*, resultant soil erosion, water and land pollution, deforestation leading to near extinction of biodiversity, *all adding* to environmental degradation. All this coupled with technology that promotes imperialism against nature, will lead to serious setbacks in the quality of our lives in the long run.

Sampark has been working to promote Income Generating enterprise in rural areas through NGOs. We recognize the pressure on rural poor, and he need *to identify and implement strategies*, technologies and projects hat lead to improved incomes in an environmentally sustainable manner.

his workshop aims at merging enterprise with environment friendly ncome Generating Projects to be able to successfully internalize the oncepts of ecologically sustainable livelihoods in the rural areas.

OBJECTIVES

he workshop would be looking at,

- State of the environment and natural resources
- Effect on quality of life of the rural poor with whom voluntary organisations work
- Discussion and information on some potential eco - friendly projects
- Exploration of ideas for possible environment friendly Income Generation Programmes

TOPICS COVERED

The workshop will be dealing with environment and enterprise issues in the rural areas. Accordingly, the programme will cover the following topics ;

- * Enterprise issues in rural India
- * Rural development and natural resource conservation
- * State of our natural resources
- * Energy technologies in rural areas
- * Building technologies in villages
- * NGOs and their role in promoting environmental sustainability

UNIQUE FEATURES OF THE PROGRAMME

- * Uncovering IGPs that are ecologically and economically viable.
- * Provides an opportunity to learn from field observation.
- * The opportunity would be used to assess the usability of the training at field and to share further learning.

FACULTY

The programme will be facilitated by resource persons from research and corporate institutions associated with issues of Environment and Enterprise.

Prof. Jagadish, IISc, Dept. of Civil Engineering, Bangalore
Mrs. Soma Dutta, TERI
Mrs. Smita Premchander, Secretary, Sampark

METHODOLOGY

The programme would comprise of lectures, case studies, group activities and presentations, open ended discussions and a field visit. The contents have been carefully planned so as to make the learning interactive and prolific.

TARGET GROUPS

The workshop would be beneficial to organisations working at the village level and those in the field of environment and related issues. Our main target groups would be NGOs and other voluntary organisations *working in the rural sector*, especially those promoting *IGPs. However, persons from Governmental* Organisations and corporate setups are also welcome to attend.

Nomination Form

ENVIRONMENT AND ENTERPRISE

Please consider my application ______________________

Mr./Ms ______________________

Sponsor Organisation ______________________

Address ______________________

Telephone ____________ Telex ____________ Fax ________

Tick ☑ Bio data of candidate attached ☐

Organisation write-up attached ☐

Enclosed please find a DD for Rs.950/-.or 450/- No ....
Dt.........

Signature

Head of Sponsor Organisation

Seal

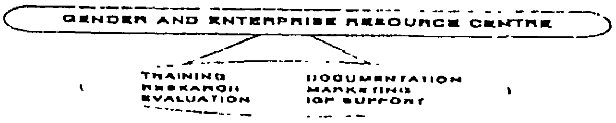
Mail to

The Coordinator,
SAMPARK,
11/1A3, Kathalipalaya, 7th Cross, 17th Main,
6th Block, Koramangala, Bangalore - 560 095.
Phone/Fax: 91-80-5530196.

- Please enclose a DD for Rs.950/- or 450/- payable to SAMPARK, Bangalore, towards registration fees.
- Please enclose your bio data and a write-up on your organization.
- Selection status will be communicated to all applicants by 1st week of August. If unforeseen events prevents selected candidate from attending, this should be communicated in writing to Sampark latest by 10th August 1997.

SAMPARK

Sampark's stated mission is to expand the capacities of vulnerable and poor people, especially women, to improve their lives, through increasing their income earning capacity. We recognize that building and expanding capacities of vulnerable people requires considerable variety of training inputs, apart from resources and infrasturctural linkages. Sampark aims to support NGOs, cooperatives and women's self help and informal groups on income generation programmes (IGP) and on Gender related activities.



Anneure 2

WORKSHOP ON ENVIRONMENT AND ENTERPRISE
SAMPARK

19th - 22nd August, 1996

SCHEDULE

DAY 1, 19th Aug 97:

09:45am - 10:30am	Inauguration
10:30am - 11:00pm	Tea
11:00am - 1:00pm	Environmental issues and Sustainability: Mrs. Smita Premchander
1:00pm - 2:00pm	Lunch
2:00pm - 4:30pm	Building Technologies : Prof. Jagadish (Fly ash bricks, mud blocks, ferro concrete tiles)
4:30pm - 05:00pm	Tea

DAY 2, 20th Aug 97 :

9:00am - 06:00pm	Field Visit (Siddaganahalli and Ungra)

DAY 3, 21st Aug 97 :

9:00am - 09:30am	Review and Feedback on Field Visit
9:30am - 10:30am	Rural Energy Policy and Renewable Energy Technologies : Mrs. Dutta / Mr. Srinivas
10:30am - 11:00am	Tea
11:00am - 1:00pm	Renewable Energy Technologies
1:00pm - 2:00pm	Lunch
2:00pm - 4:30pm	Forest Resources Protection and Regeneration: Practical Projects for NGOs: Dr. Yellappa Reddy

4:30pm - 5:00pm	Tea
5:00pm - 6:00pm	IBCPT and its Activities : Mr. Purushottam Raj
6:00pm - 7:00pm	Soil : Definition, Characteristics, Reclaimation and Watershed Management

DAY 4, 22nd Aug 97 :

9:00am - 9:30am	Review and Clarifications
9:30am - 10:30	Strategic Planning : Mrs. Smita Premchander
10:30am - 11:00am	Tea
11:00am - 1:00pm	Project Design and Proposal Preparation : Mrs. Dutta
1:00pm - 1:30pm	Lunch
1:30pm - 2:30pm	Feasibility Test for Projects
2:30pm - 4:00pm	Action Plans: Group exercise on Field Based Projects by NGOs
4:00pm - 4 30pm	Tea
4:30pm - 5.30pm	Presentations by NGOs of action plans
5:30pm onwards	Feed Back and Valedictory

Annexure 3

LIST OF PARTICIPANTS

1. Mr. L. Prakash
Shree Raghavendra Industrial Association
S/o Mr. Lakshminarasimiah
Sampige Beedhi
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2. Mr. Hanmesh Rao Maradkal
Vrukshamitra
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3. Mr. Ganesh Tantry
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Agricultural Extention Coordinator
Belman
South Kanara - 576 111

4. Mr. M. R. Mamtha
Swami Vivekananda Youth Movement
Project Coordinator
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Mysore District - 571 116

5. Mr. Nage Gowda
Swami Vivekananda Youth Movement
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6. Mr. M Chandrashekaran
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Vellore - 630 007
T.N

7. Mr. B. R. Paramesh
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Joint Manager (RD&A)
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9. Mr. Sadashiva
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10. Mr. Balaji
CEE
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11. Ms. Sujatha Naik
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12. Ms Dorothy
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13. Mr. Fidelis Mascarenhas
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Hosur - 635 109

14. Mr. Mahesh Dodmani
IDPMS
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Near Baanashankari Kalyana manatapa
Kelgeri Nagar
Dharwad

15. Mr Srinivas
Spoorthi,
Near Noorani Masjid,
Mrityndjaya Nagar
Ranebenur
Dharwad dist.

16. Mr. Bharadwaj,
CHINYARD
Tadas post
Shiggoan taluk.

17. Mr. S. Chandrashekar
Jayasagara Shikshana Samsthe
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Kolar

18. Mr. S. P. Aradhya
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Vijayakrishna Nilaya
Church Compound
Madakasira - 515 301 (AP)

19. Mr. C. C. Katenahalli
MYRADA/PLAN
Post bag no.2
Vijayakrishna Nilaya
Church Compound
Madakasira - 515 301 (AP)

20. Mrs Prameela,
Sampark,
6th Block, Koramangala,
Bangalore-560 095.

Annexure 4

LIST OF RESOURCE PERSONS

Mr. Srinivasan, Chief General Manager, Nabard, Bangalore.

Mrs. Soma Datta,TERI, Delhi

Mrs. Smita Premchander, SAMPARK, Bangalroe

Prof. Jagadish, Department of Civil Engineering, Idian Institute of Sceince (IISc), Bangalore

Mr. Srinivas, TERI, Bangalore.

Dr. Yellappa Reddy, Retaired Officer of Forestry Department of Karnataka, Bangalore.

. Mr. Purushottom Raj, India Business and Community Partnership Trust (IBCPT).

. Mr.K.S. Ravi, SAMPARK, Bnagalore.

. Mr. Santhanam, NABARD, Bangalore.

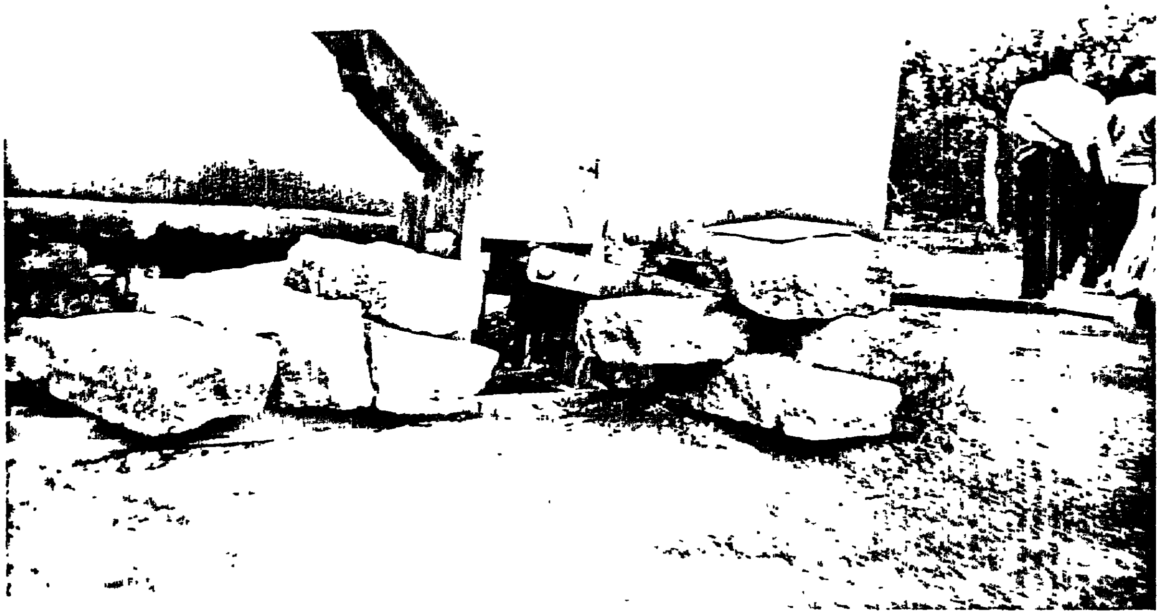
0. Mr. Negi, Geputy General Manager, NABARD, Bangalore.

Annexure 5

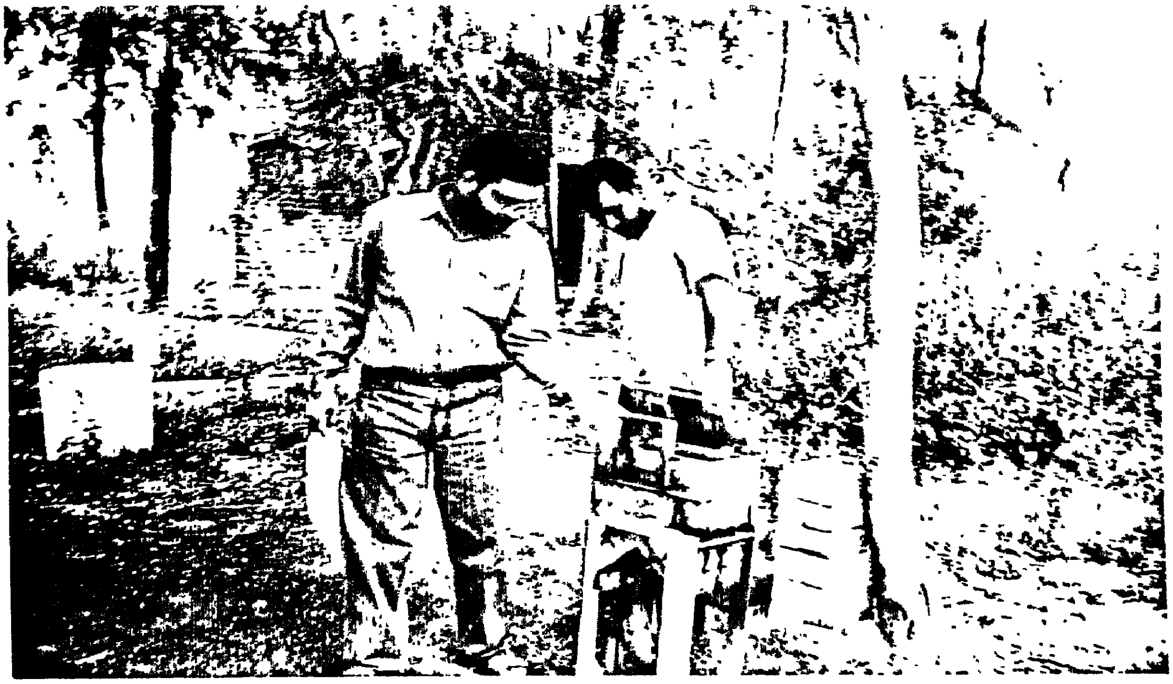
Photographic Plates

Participants listening keenly during the workshop

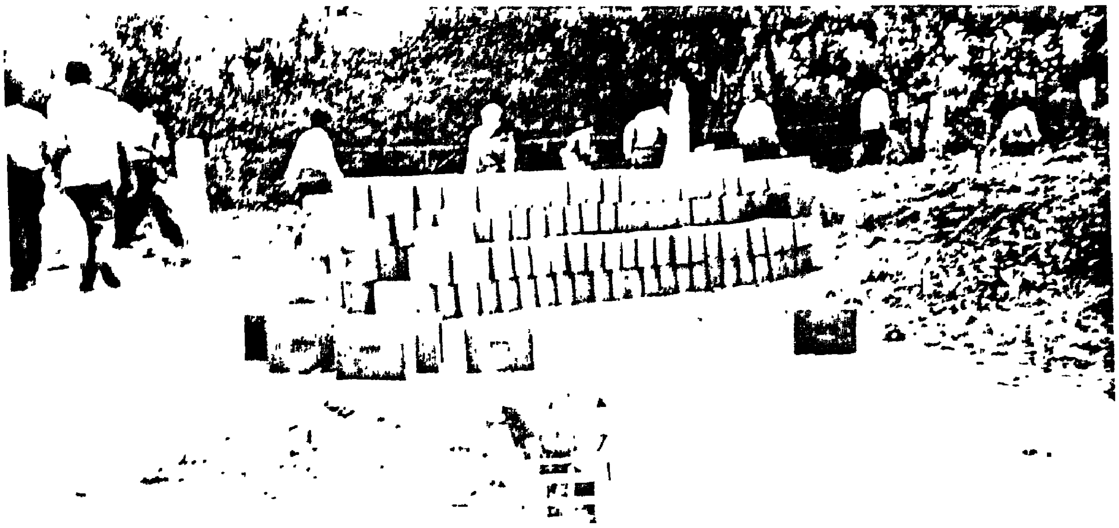
Group discussion by the participants about environmental issues



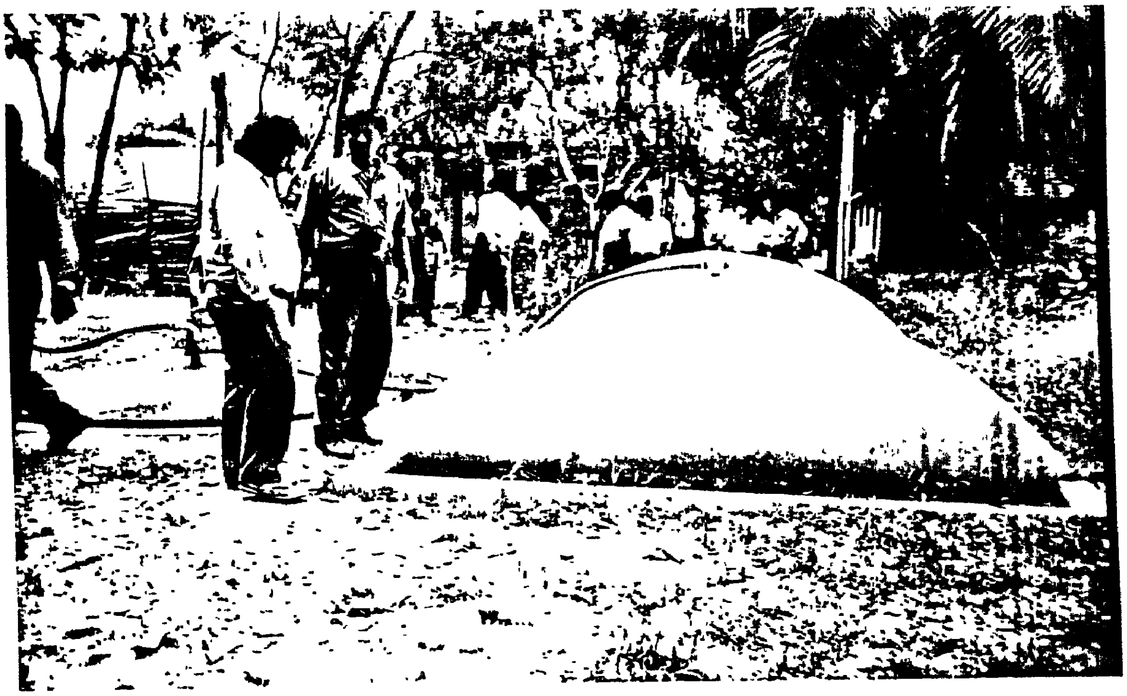
Mud-block making instrument



Understanding the structure of the mud-block machine by the participants

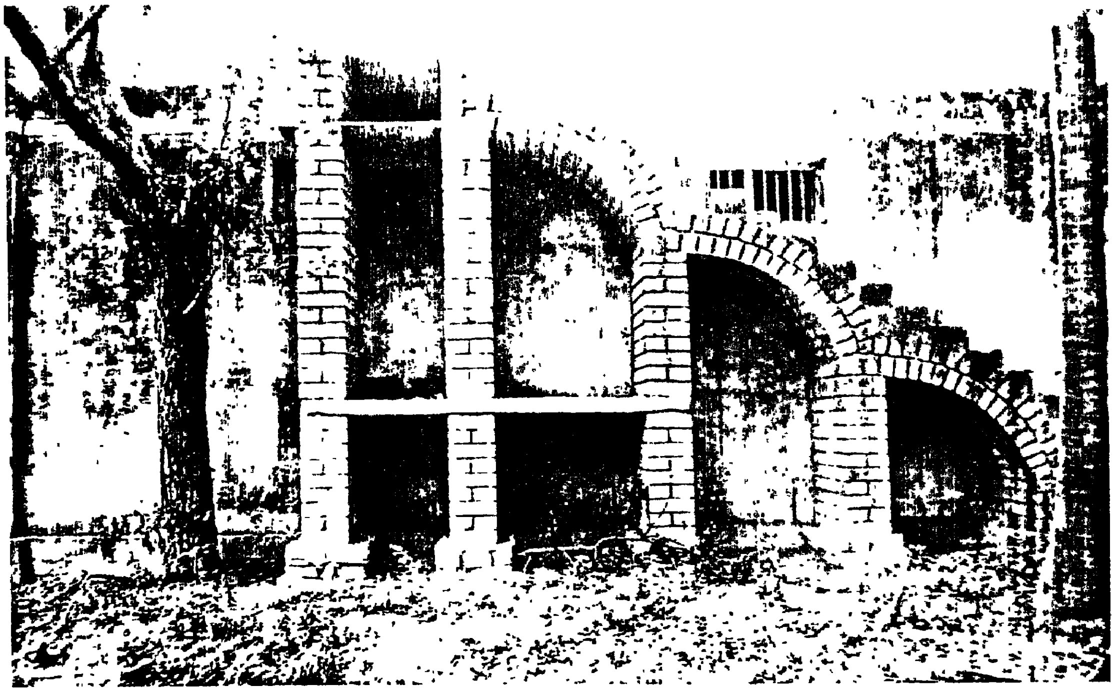


Sets of neatly pressed bricks
ba¢king in the sun.



A bio-mass plant: alternate fuel

Low cost technology can be aesthetic too, decorative arches with steamed mud blocks



Improved Chulha: Prof. Jagadish explaining about the chulha's orifice to he participants

An enlightened group after the field visits

Programme on Energy, Environment, Resources, and Sustainability (PEERS) – 1997/98

Final Project Report

Zero discharge of the effluent from Hindustan Organic Chemicals Ltd. Cochin Unit

Submitted by
Mr Boby Antony

April 1998

Conducted by: Tata Energy Research Institute (TERI), New Delhi

In collaboration with:
United Nations University, Tokyo
Institute for Energy Technology (IFE), Norway

Supported by:
Norwegian Agency for Development Corporation (NORAD)
Canadian International Development

Zero discharge of the effluent from Hindustan Organic Chemicals Ltd. Cochin Unit

Submitted by

Mr Boby Antony

PEERS'97

PROJECT REPORT

ZERO DISCHARGE OF THE EFFLUEN
FROM
HINDUSTAN ORGANIC CHEMICALS LTD
COCHIN UNIT

******

ZERO DISCHARGE OF THE EFFLUENT

FROM

HINDUSTAN ORGANIC CHEMICALS LTD ; COCHIN UNIT

BY

BOBY ANTONY

HINDUSTAN ORGANIC CHEMICALS LTD;

AMBALAMUGAL-682 302

ACKNOWLEDGEMENT

I wish to express on records my sincere thanks to Tata Energy Research Institute for providing the necessary training in carrying out this project

I am also thankful to Canadian International Development Agency (CIDA), International Institute of Sustainable Development (IISD) Canada,The Nowegian Consortium of Energy and Environment (NORCE) and Tata Energy Research Institute North America for giving necessary training to carry out the project

I am very much thankful to the IOC management for giving me an opportunity to take part in the PEERS program and for enabling me to carry out the project on "Zero effluent discharge"

My thanks are due to those who have helped me in making this project work a success

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CHAPTER-1

INTRODUCTION

1.0 INTRODUCTION

Water is a prime natural resource and a basic human need There cannot be any life without water and quality of life depends on the ability to manage available water The planning and management of this resource and its optimal, economical and equitable use are important and urgent The ever-increasing demand for water, depletion of good quality of water and serious threat of environmental pollution have given tremendous importance to water management. The available quality is limited, its utilisable portion is decreasing due to quality problem, but the demand keeps on increasing to satisfy the ever-increasing population and to produce more food, fiber and the needed industrial product Water consumption increased six fold between 1900 and 1995, twice the rate of population growth

Practically in every kind of water use whether industrial or domestic, waste in the form of effluent water or sewerage water are generated At present, wastewater management has become equally or even more important than water resource management because of environmental hazards With the ever increasing demand of water to meet the needs of agriculture, industrial and domestic purposes and the growing concerns towards pollution problem, the emphasis on waste water treatment and its reuse have increased. The earlier philosophy of waste management, to meet only the regulatory standard for its disposal, has shifted in making the waste in to valuable product and recycle. It is true in case of wastewater management also.

We can no more consider water and waste water treatment separately, today the need is, to study both issues together that is the concept of total water management This can be achieved by waste minimization and integrated water management involving water treatment, wastewater treatment, water recycle and product recovery Useful life of water can be extended through process of cascading water reuse with intelligent process control engineering and thus the volume of waste water can be reduced, saving fresh water This inturn will increase operating profit and lowers disposal cost

The need for recycle is enormous. We should try to recycle water as well as waste product in it Industries can survive only by managing water supplies, instead of depending on nature for its fresh water requirements Recycle of wastewater becomes the answer. Why waste water, because it is the assured source of water supply as long as industry is operating and there is life on earth It is now technically feasible to recycle industrial and domestic wastewater, as well as recover valuable product for reuse with cost effective scheme

As a part of the training program on energy, environment, resources and sustainability conducted by Tata energy Research institute, the participant has to carry out a sustainable development project in the area of their work

Sustainable development is development that meets the needs of present without compromising the ability of future generation to meet their own needs Agenda 21 is an action plan to steer national and the international community towards the goal of sustainable development. As per chapter 17 & 18 of Agenda 21, the area of concern are the protection of the quality and supply of fresh water resources and the protection of the ocean, all kinds of river and coastal area The alarming high pressure of population and shrinking resources of water necessitate to minimise the consumption of water in the entire field and to use the recycled water

There are innumerable environmental problems These are local environmental problem such as unsafe water, untreated sewage, polluted urban air etc There are also regional and natural environmental problems such as polluting industries, acid rain, river pollution, deforestation etc Finally there are global problems such as accumulation of green house gases in the atmosphere, ozone layer depletion etc From a holistic vision must emerge practice and here the dictum in environmental movement is THINK GLOBALLY & ACT LOCALLY Thinking globally implies thinking inter-connectedly that is with an awareness of all the interconnections In effect, this demand is equivalent to putting the entire environmental problem on a par and treats them as if they are of equal importance

The chemical and petrochemical industries are of one of the most advanced industries with regard to environmental control and management and will have a very important role in assisting organizations to move towards sustainable development It is time to say that efficient plant will maximize output and thereby profit, but will have low impact on the environment Efforts are needed to reduce water consumption and pollution

The sustainable development project, which has been selected as a part of the training program, is the "Zero Discharge of the effluent from Hindustan Organic Chemicals Ltd." by recycling

The effluent from the existing plant is treated in the centralised effluent treatment plant and the treated effluent conforming to pollution control board specification is let out from the factory to Chitrapuzha River.

There are two types of water recycling, offsite and onsite. Offsite recycle involves treatment to combined effluent and recycling of water as process or raw water Product recovery however is not possible as many products are in mixed form

In onsite recycle wastewater is segregated and treated at source, prior releasing it in to the combined effluent treatment plant This reduces the load on the combined effluent treatment plant, enhance the treatment efficiency and also enables to recover the product as well as water

The choice between offsite and onsite recycle may be made after segregation and survey of the waste water, its characterisation study and techno-commercial evaluation of the recycle process

CHAPTER-2

METHODOLOGY

2.0 RESEARCH METHODOLOGY ADOPTED

2.1 Water and Waste water audit

This audit includes study of water usage, its possible reduction in different production process It also examine all aspect of waste water production, treatment and disposal This is carried out in a view to reduce the volume of the wastewater and the quantity of the polluting element to be discharged out.

2.2 Study of treatment effluent quality

This includes the study of the effluent treatment plant, the percentage of removal of the major pollutants at each level, and also the quality of the treated effluent

2.3 Techno-economic feasibility study to reuse the treated water

Based on the water audit, identify the place to reuse the treated effluent. Study the different method of treatment to bring down the effluent quality to the required specification for reuse Also conduct the techno-economic feasibility study to select a suitable method of treatment

2.4 Design

Design the capacity of the major equipment for the treatment, after identifying the suitable tertiary treatment method

CHAPTER-3

PROCESS DESCRIPTION

3.0 PROCESS DESCRIPTION

Hindustan Organic Chemicals Ltd .(HOC) is a Govt India enterprise incorporated in the year 1960 with its registered office at Rasayani, Maharashtra for the manufacture of basic organic chemicals.

HOC's prestigious Cochin unit was set up in the year 1985-86 at Ambalamughal for the manufacture of Phenol and Acetone This plant was commissioned in the year 1987 and has an installed capacity of 40000 TPA of Phenol and 24640 TPA of Acetone HOC has commissioned a Hydrogen Peroxide plant of capacity 5225 TPA (100% H_2O_2) during the year 1997

Phenol complex consists of the following units

1 Propylene Recovery Unit
2 Cumene Unit
3 Phenol Unit

Brief process description of each unit is given below

3.1 Propylene Recovery Unit

The plant is designed to produce two grades of propylene viz Lean propylene of 75% purity suitable for the production of cumene and chemical grade propylene of 95% purity

Capacity of the Plant:

Lean Propylene (Cumene Grade): 21,840 TPA
Chemical Grade Propylene : 7,160 TPA

The process scheme consists of two fractionating columns with the auxiliaries and equipment for the removal of COS (Carbonyl sulphide) as H_2S from the hydrocarbon The first fractionator acts as C3 - C4 splitter producing 75% Propylene as top product The second fractionator functions as C3 - C3 splitter, producing 95% Propylene as top product Propylene from the C_3 - C4 splitter is treated in Caustic/ MEA and water washeing system to remove the sulphur The fractionation and caustic wash are carried out at a pressure of about 16 - 20 kg/cm^2. The heat for the reboilers is supplied by L P steam Circulating water condenses overhead vapours.

3.2 Cumene Unit.

This unit is based on M/S UOP, USA's Catalytic Condensation process. This processing technique utilises a Solid Phosphoric Acid (SPA) catalyst to promote the alkylation of benzene with propylene to yield high purity cumene (isopropylbenzene).

$$C_6H_6 + C_3H_6 \rightarrow C_6H_5CH(CH_3)_2 + \text{Heat}$$

The Overall-process flow scheme consists of combining benzene with a propane - propylene mixture at select ratio prior to the reaction zone for the assurance of maximum product quality and yield This mixture is then heated and routed to the reaction zone, where the alkylation takes place over a solid phosphoric acid catalyst The reaction zone effluent then passes through a series of fractionation columns for the rejection of non-reactants, recycle of the unreacted benzene and for the separation of the desired cumene product from the heavier alkylation products

3.3 Phenol Unit.

This unit is based on UOP's ' Cumox Process' which is a commerci established cumene peroxidation process for the economic and efficient production phenol & acetone

Capacity

Phenol	: 40,000 TPA
Acetone	24,640 TPA

The Cumox unit has been divided into the following process sections

3.3.1 Oxidation Section

This is the first step of synthesis employing the low temperature liquid ph oxidation of Cumene to Cumene Hydroperoxide (CHP) in the oxidizers (two in seri Oxygen is derived from air and the reaction is carried out in an alkaline environm The oxidation is a highly exothermic reaction

$$C_6H_5CH(CH_3)_2 + O_2 \text{ (Air) } \xrightarrow{NaOH} C_6H_5C(CH_3)_2OOH + \text{Heats}$$

3.3.2 Evaporation Section.

In this section, CHP is concentrated in two steps from approximately 25-wt % 80-wt.%. In the, first step, CHP is concentrated to approx. 40 wt% in the evaporator preflash drum In the second step, the product flows through a parallel set of wiped thin film evaporators, where the 80-wt % CHP is produced

3.3.3 Cleavage Section

Concentrated CHP from the Evaporation section is fed into two parallel cleavage reactor circuits, alongwith concentrated sulphuric acid catalyst Under controlled conditions of temperature and acidity, CHP is cleaved to Phenol and Acetone

$$C_6H_5C(CH_3)_2OOH \xrightarrow{H_2SO_4} C_6H_5OH + (CH_3)_2CO$$

3.3.4 Direct Neutralization & Effluent Treatment

This section performs four main functions

1 Neutralization of the acid used as catalyst in the cleavage section
2 Washing of salts from the organic phase, which results from the neutralization.
3 Recovery of phenol & acetone from several effluent streams
4 Springing of phenol recovered as sodium phenate from the effluent stream

3.3.5 Fractionation section.

This section mainly consists of six columns to separate and purify phenol and acetone and to recover cumene and alphamethylstyrene (AMS).

3.3.6 Hydrogenation section.

The alphamethylstyrene (AMS) is hydrogenated back to cumene The reaction is carried out over a fixed bed of catalyst

3.3.7 Tar Cracking Section.

The tar column bottoms are processed through a cracking furnace, which thermally breaks down these heavies to phenol, cumene, AMS and lighter compounds, which are recoverable, by fractionation

The overall phenol yield is marginally increased or the net consumption of cumene is slightly reduced by use of a tar cracking section A net residue is also produced

3.3.8 Tankage

The cumox unit is provided with tankage for feed stock, intermediates, final products, tempered cooling water, sulphuric acid and caustic

3.4 The cumox unit is provided with these service systems.

1 Hot Oil System

2 Steam System

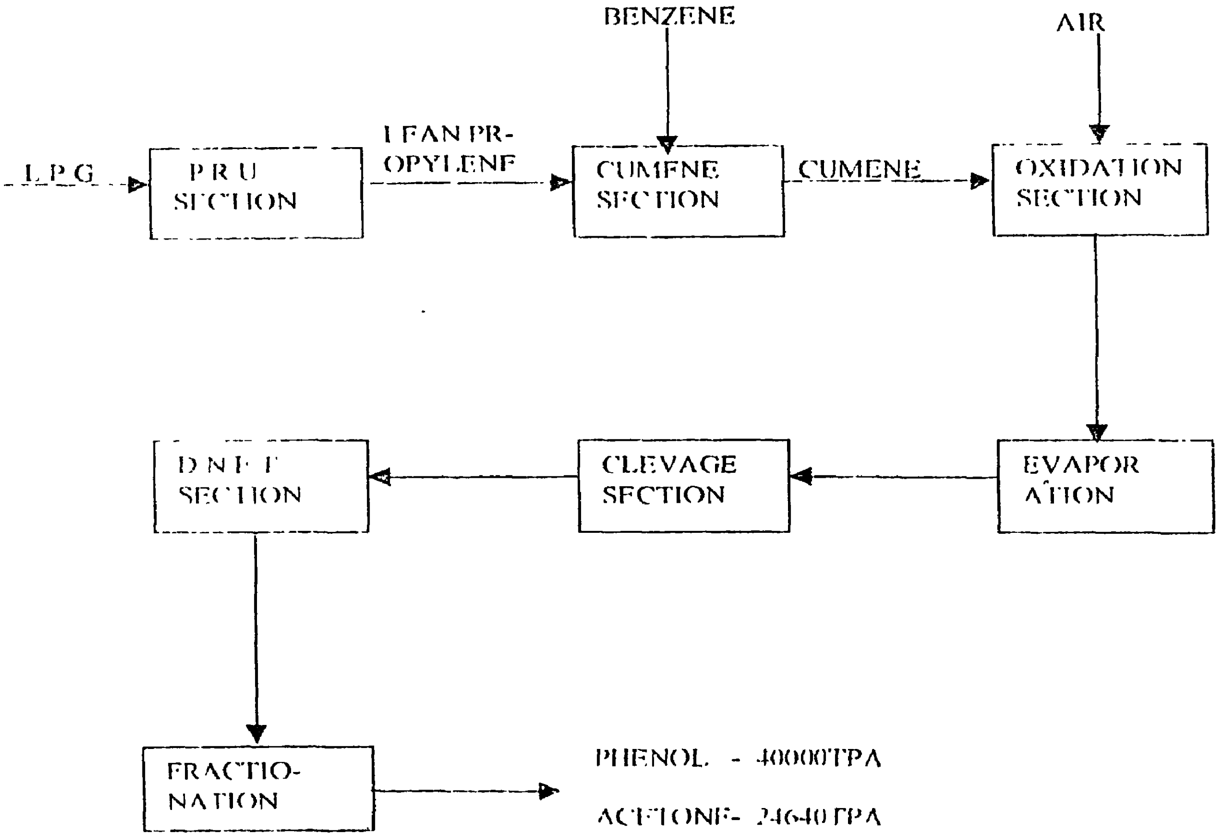
3 Cooling Water System

4. Refrigerated Water System

5. General Utility System (Nitrogen, Electricity, Process Water Etc)

FIGURE-3.1

PROCESS FLOW DIAGRAM



CHAPTER–4

WATER AND WASTE WATER MANAGEMENT

4.0 WATER & WASTE WATER MANAGEMENT AT HOC

HOC meets its water requirement from Kerala Water Authority (KWA) at Choondy and is stored in storage tank of capacity 20,000 Kl. The raw water received from KWA is treated water and its characteristic is tabulated in Table 4 1

Table 4 1

pH	6 9-7 2
M-Alkalinity	15-20ppm
Hardness	7-10ppm
Iron	0 5-1ppm
TDS	35-40ppm
Conductivity	50ppm
Chloride	20ppm

Treated raw water received from KWA is further treated to meet the portable water quality, process water requirement and also the specialized equipment water requirement viz Cooling tower, boiler feed etc

4.1 Pre treatment of raw water

Raw water from storage tank is pumped to hopper bottom tank. Water is chlorinated with chlorine to kill the bacteria and prevent algae growth Clarified water from hopper bottom tank is collected in the clarified water storage tank Water is pumped to pressure sand filter and is used as process water, cooling water and domestic water

4.1.1 Demineralised water treatment

Filtered water from pre treatment section is stored in a tank and from there it is pumped to activated carbon filter The water then enters the cation exchangers where the cations from the water are taken up by the cation resin (Indion 225) and converted to corresponding mineral acids. Water then enters the anion exchanger The anion exchanger (Indian-NIP) replaces silica and free CO2 from the water, along with chlorides and sulphates with hydroxyl group. The anion treated water enters the mixed bed containing mixture of cation (Indion 225) and anion (Indion FFIP) resins, which are in a mixed state for further polishing Back washing and regeneration of the resins are done whenever the beds are exhausted

DM water is used as the feed to the boiler and used as process water

4 2 Specialised equipment water treatment

4 2.1 Boiler feed water treatment

The following chemicals are added to treat the water before it is fed to the boiler

INDION 1461A - To adjust the pH of the water

INDION 2574 - To adjust the residual phosphate

INDION R 101 - To maintain the pH of the condensate

INDION 161 - To sevange the oxygen

(Catalyzed hydrazine hydrate)

The quality of the Boiler water & Boiler feed water is as follows

Boiler Water.

pH	9.5 -10.5
PO_4	30-50 ppm
TDS	1600 ppm (max)
Conductivity	1000 micro mhos (max)
Silica	10 ppm (max)
Hydrazine	2ppm

Boiler Feed Water.

pH	8 - 9
Hardness	1.0 ppm(max)
Iron	0.10 ppm(max)
Conductivity	100 micro mhos(max)
Silica	1.0 ppm max

4.2.2 Cooling water treatment

Indion 3599 is added as an anticorrosive, antifoulant and antiscalant chemical to the cooling water. Indion 1594 & 7106 is added in shock dose as a biocide. Indion 9077 is added as micro dispersent. Chlorination is done in every day to the cooling water.

The quality of the cooling water

pH	6.5 -7.5
TDS	250 ppm(max)
Hardness	120 ppm(max)
M- Alkalinity	100 ppm (max)
Chlorine	0.5 ppm (max)
PO_4	10-20ppm
Iron	0.5-1ppm

4.3 Waste Water Management

The effluents are generated from process, Boiler, DM plant, cooling tower & domestic The effluent from the process are initially treated in the primary treatment to ecover the phenol and hydrocarbon before it is let out for secondary treatment .

The effluents from other section along with the effluent from the primary reatment section are treated in the centralised effluent treatment plant.

4.3.1 Primary treatment section:

Cumene Extraction column

The wash water from the cumox section are passed through cumene extraction column to recover the cumene hydroperoxide and other hydrocarbons from the water before it is let out for secondary treatment

Oil Extraction Column

Phenol and other hydrocarbons from the effluent of DNET and fractionation sections are extracted by cumene in oil extraction column The effluent is then let out for secondary treatment

4.3.2 Secondary treatment

Effluent treatment plant

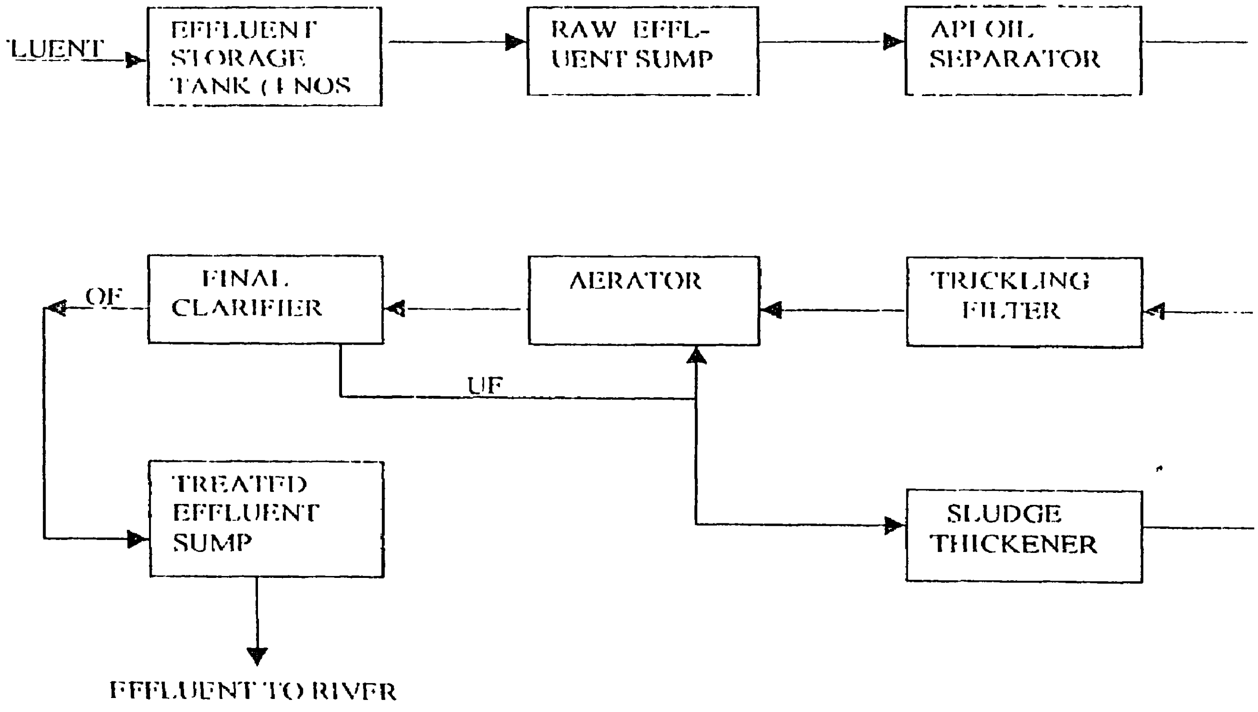
The process effluents from cumene and cumox plants are collected in the mixing tank Other effluents from the cumene, cumox, fractionation and tankage area collected in the raw effluent equalisation tank (REET) The effluent from propylene recovery unit is collected in sump The effluents from DM plant and boiler section are collected in a pit near DM plant All the effluents from mixing tank, REET, propylene plant and DM plant sumps are mixed in a raw effluent sump The combined effluent is then taken to API oil separator After the oil removal in API oil separator, the effluent is taken to the flash mixer, where the reagents like ferrous sulphate for the removal of emulsified oil and lime for pH adjustment, if needed, are added The coagulated emulsified oil and colloidal particles are settled in the clarifloculator The clarified effluent free from oil and suspended particles is fed to the trickling filter along with sufficient nutrient urea. The trickling filter effluent is then pumped to the aerator Microbal populations in the aerator assimilate the organics including phenol The effluent from the aeration tank is taken by overflow weir to final clarifier The clear over flow from the final clarifier is collected in the final disposal tank and from there it is pumped to Chitrapuzha River

A part of the settled sludge in the final clarifier is recirculated back to aerator to maintain the required MLSS concentration The excess sludge from aerator along with clarifloculator under flow is taken to sludge thickener The thickened sludge from the thickener is kept in the sludge lagoons for extended anaerobic digestion

A schematic diagram of the effluent treatment plant is shown in fig 4 1

FIGURE-4.1

EFFLUENT TREATMENT FLOW DIAGRAM



CHAPTER-5

WATER AND WASTE WATER AUDIT

5.0 WATER AND WASTE WATER AUDIT

Increasing environmental awareness and rising water treatment costs have led to a growing desire to reduce raw water consumption and wastewater discharges in the process industries Water and Waste water audit is an in-depth study carried out to know the quantity and quality of incoming and outgoing (waste) water and to examine the means adopted for reducing their quantity and improving the quality of the outgoing water not only for meeting the consent terms granted by the regulatory agencies but also with a view to keep the environment clean and healthy so as to full fill a wider social and moral obligation to carry out their business system Water is consumed in our industry as process water, cooling water and domestic water The water requirements and the total water balance for our unit is given below

5.1 Water consumption & Water balance

5.1.1 D M Water

A) Boiler feed water

D M Water is used as the feed water f r boiler and steam generating unit in cumene plant The quantity of steam production, lant wise consumption and balance of boiler feed water & Condensate is tabulated in Tab 5.1 & 5 2 and Fig 5 1

Table-5.1

STEAM PRODUCTION

SL. No	Description	Pressure Kg/cm2	Quantity MT/day
1	Boiler	18.0	52.8
2	Boiler	5.5	98.4
3	Boiler	4.0	4.8
4	Boiler	2.2	72.0
5	Recycle Column (Cumene Plant)	1.75	144.0
6	Cumene Column (Cumene Plant)	4.0	72.0
Total			444.00

L.P.G

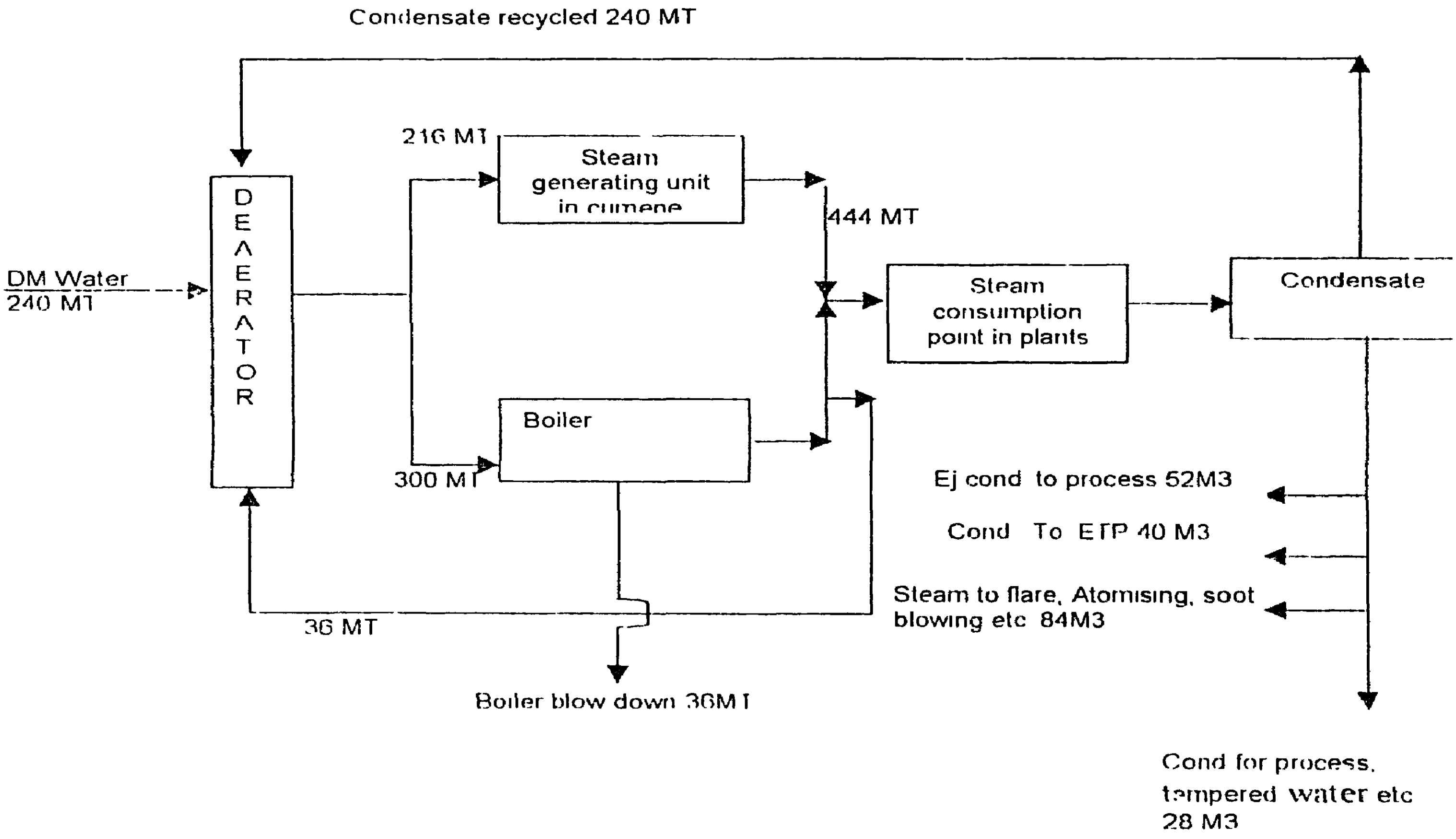
Table-5.2

STEAM CONSUMPTION

SL. No	Steam consumption points	Quantity Mt/day
1	Propylene plant	48.0
2	Evaporator pre flash heater	104.4
3	Evaporator	27.6
4	Evaporator	30.0
5	Ejector (evaporator&fractionation)	52.8
6	FAC reboiler	72.0
7	CAC feed steam heater	16.8
8	Atomising steam to hot oil	8.4
9	Flarestack, sootblowing,tanktracing	84.0
		444

FIGURE-5.1

BALANCE OF BOILER FEED WATER &CONDENSATE



Condensate recycled 240 MT
216 MT
Steam generating unit in cumene
444 MT
D E A E R A T O R
DM Water 240 MT
Steam consumption point in plants
Condensate
Boiler
300 MT
Ej cond to process 52M3
Cond To ETP 40 M3
Steam to flare, Atomising, soot blowing etc 84M3
36 MT
Boiler blow down 36MT
Cond for process, tempered water etc 28 M3

B) Process water

I) DM water is used as a process water for the preparation of 5% and 15%caustic.

II) A part of the condensate is used in cumene section.

III) Ejector condensate from evaporation &fractionation section is used

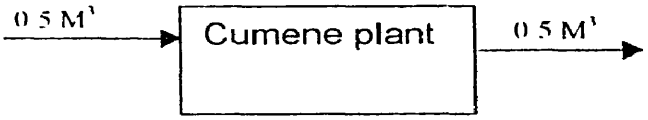
The quantity of DM water, condensate used as process water and the process effluent generated from each plant are tabulated in fig.5.2. The overall balance of process water is shown in fig 5.3.

The Overall balance of the DM water is presented in fig 5.4

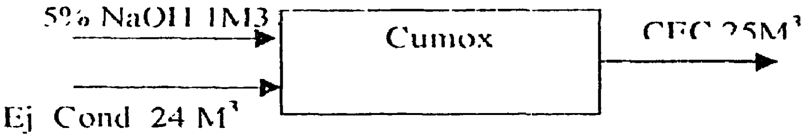
FIGURE-5.2

PROCESS WATER CONSUMPTION & QUANTITY OF EFFLUENT

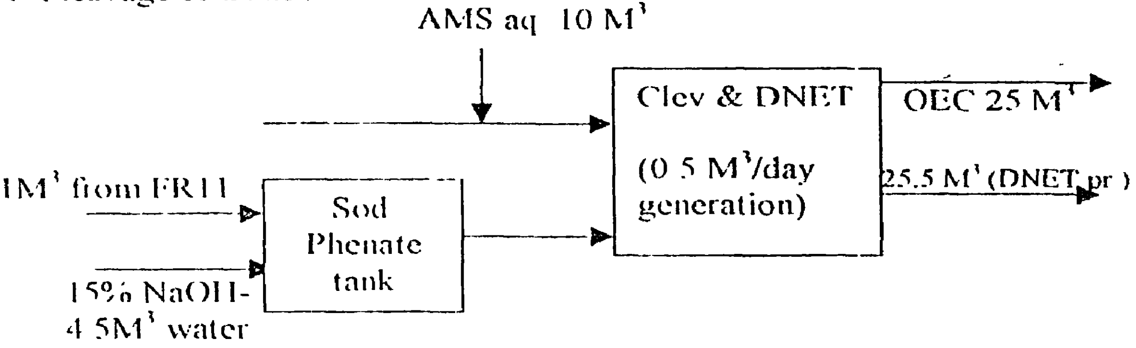
1. Cumene Plant



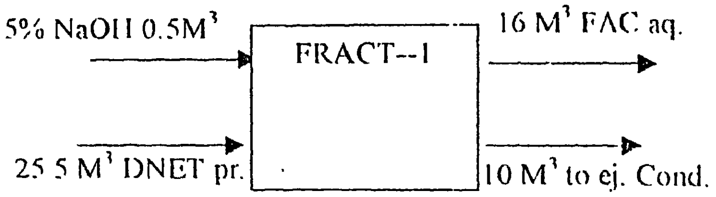
2. Cumox Section



3 Cleavage & DNET



4 Fractionation-I



5 Fractionation-II

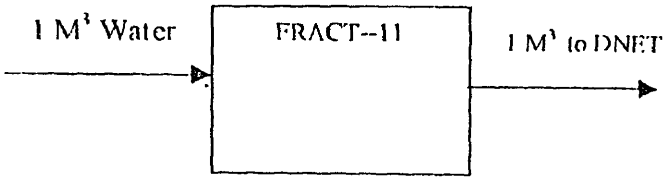


FIGURE-5.3

OVER ALL BALANCE OF PROCESS WATER

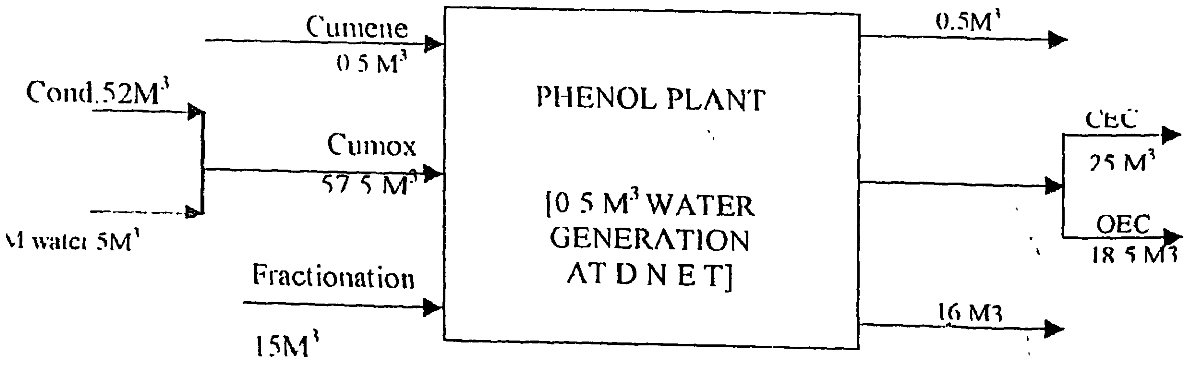
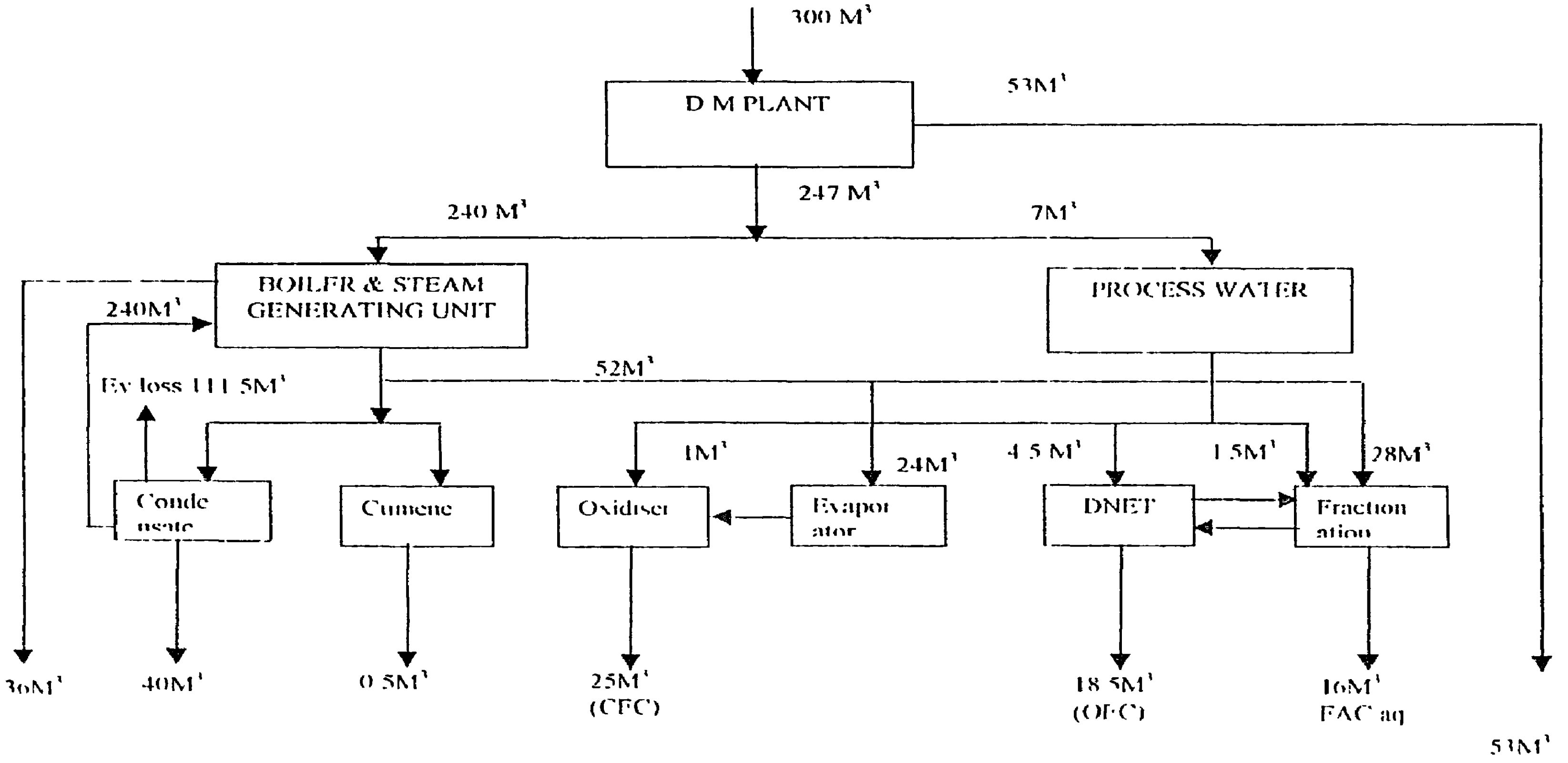


FIGURE-5 4


300 M³
D M PLANT
53M³
247 M³
240 M³
7M³
BOILER & STEAM GENERATING UNIT
PROCESS WATER
240M³
52M³
Ev loss 111 5M³
1M³
24M³
4 5 M³
1 5M³
28M³
Conde nsate
Cumene
Oxidiser
Evapor ator
DNET
Fraction ation
36M³
40M³
0 5M³
25M³ (CFC)
18 5M³ (OFC)
16M³ FAC aq
53M³

5.1.2 COOLING WATER

Cooling water is supplied to heat exchanger, compressors etc. in the plant and is recycled to the cooling towers. It is also supplied, as gland cooling in pumps which is not recycled The main losses are due to the windage and evaporation, blow down and water used as gland cooling of pumps. These losses are made up with fresh water.

A. Windage & Evaporation loss

Circulation volume, R = $4800M^3$

Temperature difference, T = 8^0C

Cycle of concentration, C = 4

Windage & Evaporation loss = $R * T*C/1000(C-1)$

= $4800*8*4/1000*3$

= $51.2\ M^3/hr$

= $1229\ M^3/day$.

= Approx $1200M^3/day$.

Windage & evaporation loss is maximum during summer season. The above values are for summer season These values are less for other seasons.

B. Quantity of water used as gland cooling

The quantity of water used for gland cooling in each pump is measured and tabulated in Table-5 3

C. Overall balance of cooling water is presented in Fig.-5.5.

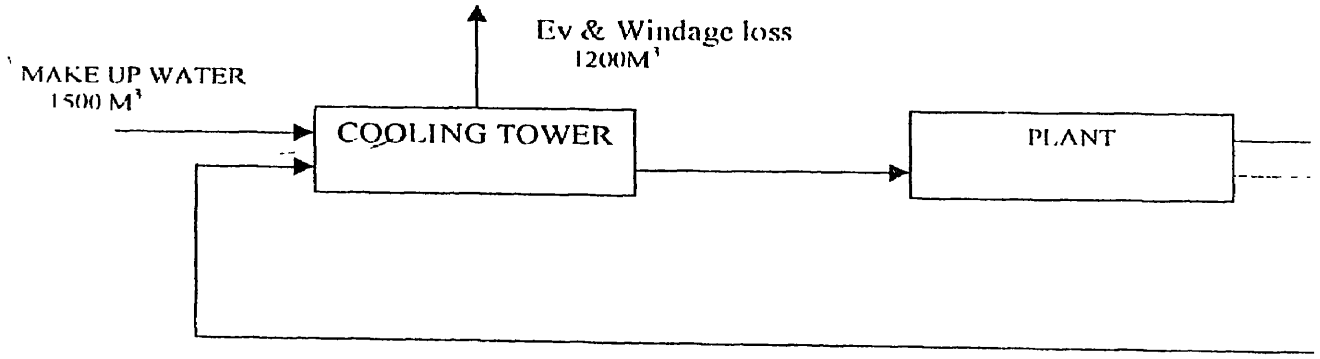
TABLE-5.3

Water consumption for gland cooling of pumps

Section	Area	Quantity M3/day	TOTAL M3/day
Propylene plant	Lean propylene pump	86	86
Cumene plant	Combined feed pump	25	
	LPG product pump	17	
	Recycle benzene pump	5	
	Rerun cumene pump	9	
	Benzene feed pump	25	81
Cumox	CHP eduction pump	17	
	Sodium phenate pump	2	
	15% caustic pump	1	20
Fractionation	Hydrogenation charge pump	9	
	PRC reflux pump	9	
	Tar transfer pump	9	
	Tempered hot oil pump	17	44
Boiler	Boiler feed pump	59	59
Cooling Tower	Cooling water pump	10	10
		Total	300

FIGURE—5.5

OVERALL BALANCE OF COOLING WATER



5.1.3 DOMESTIC WATER

Domestic water service points are provided in all the plants, canteen an administrative office Firewater, emergency showers and eyewash in the plants ar consumed from domestic water. Domestic water is also provided to township an neighboring areas

Domestic water consumption and the effluent to ETP is also tabulated in Table-5 4

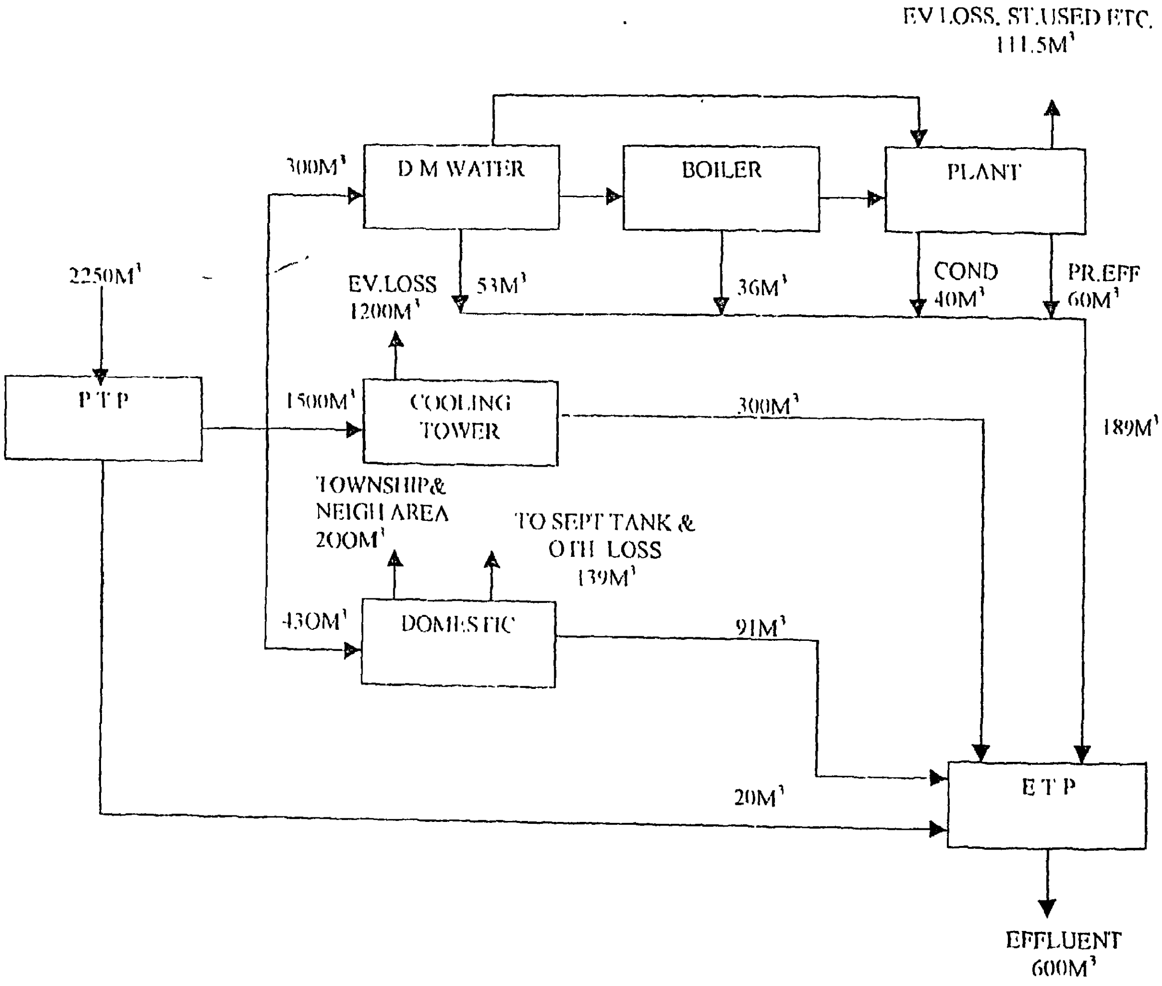
Overall balance of the water consumption for phenol plant and the effluent generated from phenol plant are presented in Fig -5.6

TABLE 5-4

Area	Quantity of water consumed M^3/day	Quantity of effluent to ETP M^3/day
Town ship	175	0
Neighboring area	25	0
Domestic use	150	50
Firewater, water for hydrated phenol, CPP, lab etc.	80	41
	Total	91

FIGURE 5-6

OVERALL WATER BALANCE



5.2 EFFLUENT

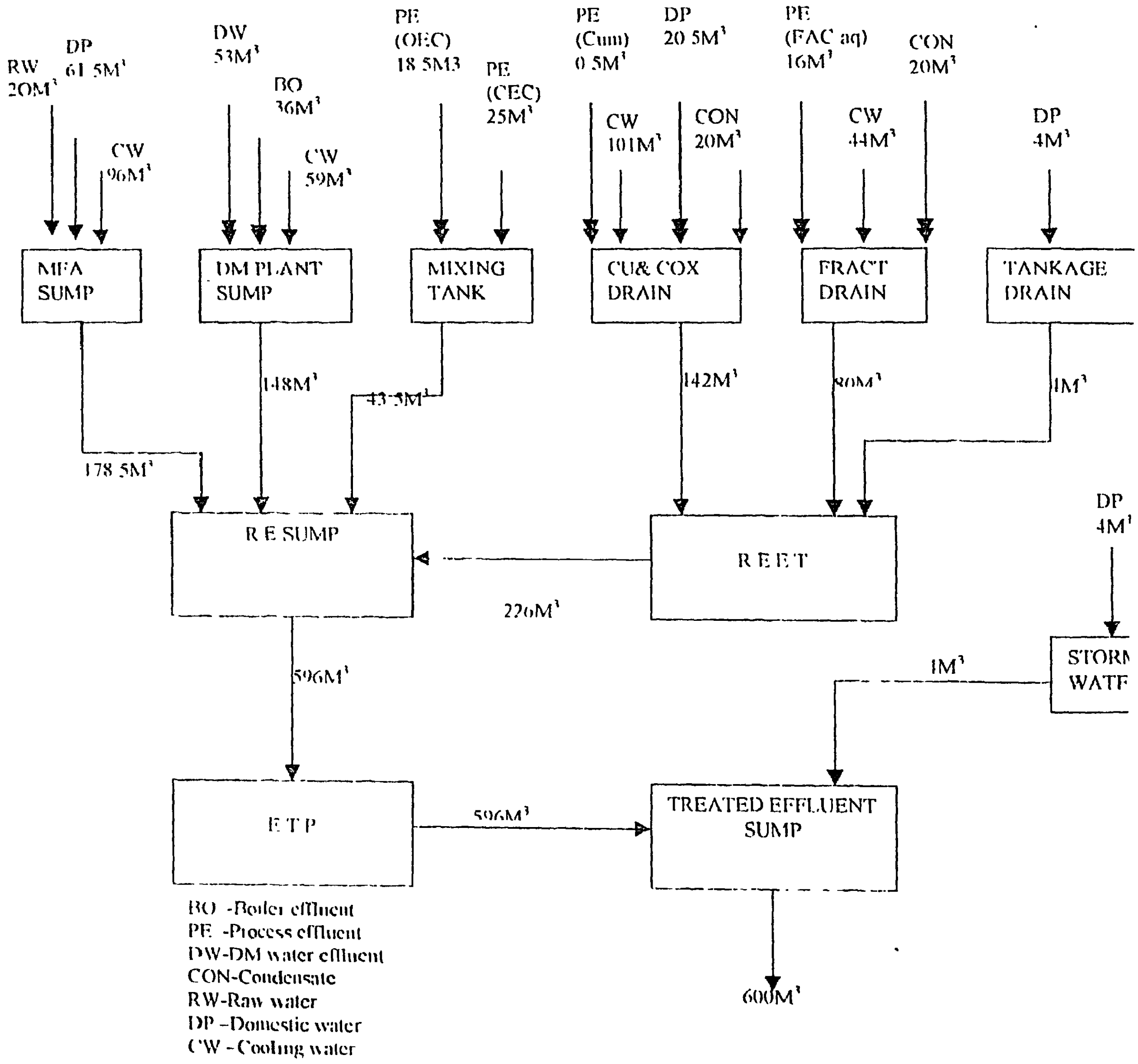
The effluents from the phenol plant are collected in different storage tanks. The quantity of the effluent generated from each category are tabulated in Table-5 5

The effluent collected in different storage tanks are presented in fig-5.7

TABLE-5 5

SL NO	DETAILS	QUANTITY M^3/day
1	Raw water from P T P	20
2	Process effluent	60
3	Cooling water	300
4	D M water	53
5	Boiler blow down	36
6	Condensate	40
7	Domestic water	91
	TOTAL	600

FIGURE5-7



BO -Boiler effluent
PE -Process effluent
DW-DM water effluent
CON-Condensate
RW-Raw water
DP -Domestic water
CW - Cooling water

5.3 Effluent treatment plant performance

The analysis of the individual stream collected in effluent treatment plant is tabulated in Table-5 6

TABLE—5.6

SL No	Stream	Flow M^3/day	pH	Phenol Ppm	C O D Ppm	B O D ppm	T D S ppm	SO_4 ppm
1	Mixing tank	43.5	7.7	100	10500	3100	33700	22400
2	Fractionation drain	80.0	6.8	80	200	50	550	10
3	Cumene & cumox drain	142.0	10.5	25	120	20	212	10
4	Tankage drain	4 0	7.6	6	20	ND	45	5
5	DM Plant&Boiler	148.0	11.0	ND	8	ND	205	60
6	M E A Sump	178.5	7.0	ND	8	ND	130	40
7	Storm water drain	4.0	7.0	ND	8	ND	45	5
	Combined effluent	600.0	9.0	50.0	830	235	2650	1650

The Phenol,COD and BOD in the combined effluent normally vary as there was some leaks in the plant

The effluent from the plant are collected and treated in effluent treatment plant by physical,chemical and biological treatment metods The analysis of the major pollutants at each stage was conducted to study the percentage of removal of pollutants and tabulated in Table 5-7

TABLE 5-7

Parameters	Unit	Combined Effluent	A P I OIL Separators	Trickling Filter	Aerator
PH		9.0	9.0	7.9	7.8
Phenol	ppm	70	70	0.5	0.2
C O D	ppm	800	800	57	32
B O D	ppm	400	400	2	1
T D S	ppm	2650	2650	2650	2650
Sulphate	ppm	1650	1650	1650	1650
Oil&Grease	ppm	10	ND	ND	ND

The percentage of removal of critical parameters are tabulated in Table 5-8

Parameters	Trickling Filter outlet,%	Aerator outlet,%
Phenol	99.3	99.7
C O D	93	96
B O D	99.5	99.8

Oil and Grease was completely removed in A P I Oil separator. Total dissolved solids and sulphate are not removed from the effluent as there is no treatment facilities in our treatment system to remove the same.

The typical complete analysis of the effluent before and after treatment and Kerala State Pollution control Board specification is tabulated in Table-5.9

TABLE—5 9

SL No	Parameters	Unit	Influent to E T P	Treated effluent	K S P C B Norm
1	PH	---	9.0—9.5	8.0-8.3	6.5-8.5
2	Phenol	ppm	75—100	0.3-0.7	1.0(max)
3	COD	ppm	800-1000	32—80	250(max)
4	BOD	ppm	300—500	3—10	30(max)
5	Total suspended solids	ppm	100	5—20	100(max)
6	Fluoride	ppm	ND	ND	5(max)
7	Sulphide	ppm	ND	ND	2(max)
8	Total chromium	ppm	ND	ND	2(max)
9	Hexavalent chromium	ppm	ND	ND	0.1(max)
10	Cyanide	ppm	ND	ND	0.2(max)
11	Total ~~suspended~~ Dissolved solids	ppm	2650	2650	--
12	Sulphate	ppm	1650	1650	--
13	Oil & grease	ppm	18	ND	--
14	Phosphate	ppm	10	10	--
15	Iron	ppm	0.5	0.3	--
16	Chloride	ppm	20	20	--
17	Silica	ppm	30	30	--
18	Total hardness	ppm	20	30	--
19	P -alkalinity	ppm	12	5	--
20	M—Alkalinity	ppm	80	400	--

5.4 Recommendation

5.4.1 Process water

The process effluent from FAC aqueous at present is draining to effluent treatment plant There is already a provision to divert it to ejector condensate FAC aqueous has to be diverted to ejector condensate drum for the treatment in primary effluent treatment section

5.4.2 Cooling water

Recycling of the gland cooling water to cooling tower. This not only reduce the consumption of make up water in cooling tower but also reduce the consumption of cooling water chemicals

5.4.3 Treated water

Recycle of the treated effluent to the extent possible Major consumption in the plant is the cooling water makes up Further study has to be conducted on the feasibility on the tertiary treatment of the treated effluent for the reuse of the same as cooling water make up.

CHAPTER-6

WATER RECYCLE

6.0 WATER RECYCLE

An integrated water and waste water management scheme adopted by industries have given rich dividends by way of pollution abatement, waste water reuse and using the Zero discharges concept The conventional methods for water and wastewater treatment have been in practice since the industrial revolution These methods concentrate with the objective of safe disposal of effluent. The water scarcity problem, stringent water quality requirement and also the increased awareness towards environmental pollution have resulted in the various R&D and the evolution of so called modern technology These not only gave safe disposal of effluent but water recycle and converting effluent waste in to a profitable proposition by recovering valuable chemicals from it are also looked in to

Fresh water costs are increasing worldwide, and with discharge regulations getting tighter, industries are forced to consider expensive new wastewater treatment facilities These factors are the main driving forces for minimising fresh water demand and wastewater generation One should make systematic approaches to the minimisation of fresh water demand and wastewater generation through the maximisation of the reuse of the water within the process

Direct reuse.

The outlet water from one unit operation is used to satisfy the water demand of another operation.

1) In HOC the ejector condensate from the evaporator section are used as wash water to wash the caustic from the oxidiser product. Similarly the ejector condensate from

The wash water used in cumox and fractionation section treated in the primary treatment section to recover the phenol and other hydrocarbons before it is let out for secondary treatment

This not only reduce the consumption of water there by reducing the generation of the waste but also reduce the pollutant load to effluent treatment.

I) Based on the audit it was found that the water used for the gland cooling of pumps, compressors are not recycled. This water can be recycled back to cooling tower. This not only reduces the consumption of makeup water in cooling tower but also reduces the consumption of cooling water chemicals

Regeneration re-uses.

The outlet water is given some treatment to make it suitable for reuse in the system. The effluent from the existing plant is treated in the centralised effluent plant and let out to Chitrapuzha River. Based on the audit, it was found that the treated effluent confirm to the standards specified by State Pollution Central Board and the norms of MINAS. The treated effluent can be recycled and reused in the system after proper treatment

The main parameters in the treated effluent objecting the reuse of the treated effluent are the total Dissolved Solids (TDS) and sulphate. Total dissolved solids in the treated effluent are due to the sodium sulphate generating in the process plant The removal of the Dissolved solids brings down the TDS and sulphate in the treated effluent.

The major consumption of water in the plant is the cooling water make up By proper tertiary treatment of the treated effluent to bring down the Dissolved Solids, the water can be used as cooling water make up

The Recycle of the effluent has the following advantages

1) It helps in conserving ground water resources when looked at long term implications
2) It helps in minimisation of waste generated and subsequently easier handling
3) It makes the plant intra dependent to a large extent ensuring critical system need not stop functioning due to external affairs
4) It helps to enhance the Company's image
5) It has obvious advantageous implication on ISO 14000

Stages in Recycle.

Recycle would involve the following stages

1) Tertiary treatment
2) Advanced wastewater treatment

Tertiary treatment would involve removal of contaminants viz Phenol, COD, suspended solids, silica etc

Advanced wastewater treatment would involve removal of total dissolved solids The product water from the second stage would then meet the parameters for cooling tower make up.

7.0 SELECTION OF ADVANCE WASTEWATER TREATMENT.

Various technological options are available for the advanced wastewater treatment to remove the total dissolved solids

- Reverse Osmosis
- Electro Dialysis
- Flash Distillation.
-

7.1 Reverse Osmosis.

Reverse Osmosis is a membrane separation process in which the solvent (water) molecules from a pressurised solution flow through a semipermeate membrane The membrane acts as a barrier to the flow of solute (dissolved solids) molecules, there by separating the solvent from the solute Reverse Osmosis membrane rejects ionic species, colour, organic to make water low in total dissolved solids for recycle / reuse RO unit requires pretreatment of the water

The treated water from the RO units is to be further treated to confirm standards required for make up water to cooling towers

Advantages.

1 RO unit performs a separation without a phase change

2. The energy consumption is very low

3. RO unit is primarily used to remove the total dissolved solids, but at the same time it removes dissolved Si O_2, Colloidal matter and high molecular weight organics.

4. RO systems are compact, and space requirements are less
5. RO equipment is familiar, so unskilled operators usually can be taught in a short period of time how to operate the plant.
6. Automatic controls are designed to protect the system and to prevent catastrophic failure; and if shut down occurs, less than half an hour is only required for start up

Limitations.

The upper operating temperature limits for cellulose acetate, aramid and thin film composite membranes are 30 - 40 °c, 35 - 45°c, and 45 - 50° c respectively. Above these limits, excessive loss in productivity occurs because of membrane compaction. Thus, feed streams that exceed these limits must be cooled before RO can be applied.

All RO membranes and devices are susceptible to fouling; the RO process usually cannot be applied without pretreatment

7.2 Electro Dialysis

Electro dialysis (ED) is a desalting process in which ions are removed from water by passing through the semipermeable membranes that are impervious to water A direct current electrical field transports the ions through the membranes.

ED also requires pretreatment to achieve optimum performance.

Advantages

1) ED also performs separation without phase change .
2) Post treatment is not required
3) The process eliminates the need for the continuous addition of acid .

Limitation.

1) Organic matter, colloidal and Si O_2 are not removed by ED process
2) Because ED stacks are susceptible to fouling, feed water pretreatment is necessary.
3) In general control for ED systems are elaborate and maintaining these at optimum can be difficult
4) A stack can be periodically cleaned in place with relatively ease It has to be cleaned two to four times in a year This is not only labor intensive, but can result in damage to the stack if not done properly.

7.3 Flash distillation

Flash distillation is another method to remove the total dissolved solids from the water

Of these, Reverse Osmosis has gained popularity in our country because it is cost-effective, relatively easier and based on simple logic

CHAPTER - 8

DESIGN OF REVERSE OSMOSIS SYSTEM

8.0 DESIGN OF REVERSE OSMOSIS SYSTEM.

8.1 Pretreatment

For optimal performance, water feed to the RO devices should be treated to remove gross amount of solids and to prevent fouling by precipitation or biological growth inside the device. Therefore, upstream of RO system, various pretreatment must be carried out on most water.

8.1.1 Pressure sand Filtration.

This is a standard tertiary treatment to bring down the level of suspended solids. It also serves to guard the downstream units. Effluent is allowed to pass through a bed of sand, gravel and pebble media which filters the water.

Suitable back washing is done from time to time when there is accumulation of dirt on the beds. As a normal practice, air blowers are provided for air scouring the bed before backwashing, if capacity of plant exceeds 25 m^3 /hr

a)	Filtration rate	[10 m^3/ hr] /m^2 of filtration area
	Flow rate	30 m^3/hr
	Filtration area	3 m^2
	Size of vertical sand filter	2.0 m dia & 2.0-m ht
b)	Backwash rate	(1.75) * Flow rate or [20 m^3/hr] / m^2 of Filtration area.

Back wash capacity of the pump shall be 80 m^3/hr

c)	Air blower capacity	: 50 * m^2 of Filtration area
	Capacity	: 200m^3 /hr.

8.1.2 Chlorination

Chlorination is employed for disinfection. Due to the safety hazard of chlorine gas, sodium hypochlorite finds widespread acceptance as an effective chlorinating agent.

Dosage quantity : 15 ppm NaOCl
Quantity of NaOCl required 0.45 kg/hr.
Solution strength : 5 % r. (w/v)
Dosage rate : 8.9 litres/hr.
Dosing pump capacity : 0 – 20 litres/hr.
Provide a tank of capacity : 500 litres.

8.1.3 Activated Carbon Filtration

Activated Carbon Filtration is used for removing residual organic present after secondary treatment, residual colour, free chlorine etc.

Filtration rate : [15 m^3/hr] / m^2 of filtration area.
Filtration area : 2 m^2
Provide vertical ACF of size 1.6 m dia & 1.7 m ht

8.1.4 Descalant

Sodium hexa metaphosphate (SHMP) is a chemical added to prevent scaling of sparingly soluble salts and silicate inside the membrane.

Dosage rate : 20ppm.

Quantity of SHMP required : 0.60 kg/hr

Dosage rate : 6 litres/hr

Dosing pump Capacity : 0-10 litres/hr.

Provide one HDPE tank of capacity 250 litres

8.1.5 pH Correction

The pH of the RO inlet can be in the range of 4 – 11 for polyamide membranes. If the pH is in the acidic range, it helps in non formation of salts (coating of sparingly soluble salt in the membrane). The formation of the salt is indicated by a parameter Langlier Saturation Index (LSI). If LSI is negative, it indicates salt formation minimum. To maintain LSI as negative or Zero, the PH is to be in the range of 5.5 – 6.0. Sulphuric acid or hydrochloric acid is used for pH Correction

8.2 Reverse Osmosis Treatment

Basis for the design of RO system

Treated effluent Quality & Quantity (from effluent treatment plant)

Flow : 600 m^3/day

Assuming 20 hrs of operation of RO unit.

Design flow of RO unit : 30 m^3/hr

Treated effluent Quality form ETP

pH : 8.0-8.3
Phenol : 0.2-0.5ppm
COD : 16- 40ppm.
Oil and Grease : Nil.
TDS : 2650 ppm.
SO_4 : 1650 ppm.
Phosphate (as Po4) : 5ppm.
Iron : 0.3 ppm.
Chloride : 20 ppm.
M-Alkalinity : 400 ppm.
Silica : 20 ppm.
BOD (3 days at 27 °c) : 5 ppm.
Total suspended solids 10 - 20 ppm.

8.2.1 High pressure pump

According to the TDS, the feed pressure varies For < 3000 ppm TDS, the feed pressure is from 150-250 psi

8.2.2 Micron filter

The micron filter is used as a guard filter to prevent minute suspended solids from entering inside the membrane This filter has polypropylene candles inside a SS316 or MSRL pressure vessels.

The micron filter is a critical unit before R.O, as it prevents suspended solids from entering the same

8.3 Reverse Osmosis module

Two types of membranes are available Polyamids & cellulose acetate Nowadays Polyamids membranes are gaining preference because of their advantages over the cellulose acetate membrane Usually spiral wound configuration is used for TDS level up to 3000 ppm Normally for TDS up to 3000 ppm, it is possible to achieve up to 80-85 % recoveries.

8.3.1 To find out number of membrane.

GFD	GPD /(X* SA)
GFD (Flux density)	For effluent GFD =10-12gallons / day / ft ^{2}
GPD (Flow rate in gallons / day)	30 * 24 * 265 = 1,90,800 gal/day
SA (Surface area/ membrane)	For spiral wound configuration is320-370 ft^2
	Normal value is 340 ft^2
X (No Of membrane)	1,90,800/12 * 340 = 46 7 = 47 Nos
Assuming 10 % extra	
Total number of membrane	52 Nos

8.3.2 Number of membranes in each stages

Now we introduce staging in a RO process The actual reductions take place in stages Normally two or three-stage configuration is employed The reject from the first stage becomes feed to the second stage and the reject from the second stage becomes feed to the third stage

Around 6 to 8 membranes are lodged in one pressure vessel and usually the configuration goes like

X + X/2 + X/4 : 52 where 'X' is the no. of membrane in stage1.

Stage 1

The actual number of membrane in stage1 = 32 and the staging is 4 x 8 i e there are 4 pressure vessels in stage 1 each of which has 8 membrane

Stage 2

No. Of membrane in stage 2 = 16 and the staging is 2 x 8 i e there are 2 pressure vessel in stage 2 each of which has 8 membrane

Stage 3

No Of membranes in stage 3 = 8 and the staging is 1 x 8 i e there is 1 pressure vessel in stage 3 each of which has 8 membranes

The final configuration will look like

4 x 8 = 32 in stage 1
2 x 8 = 16 in stage 2
1 x 8 = 8 in stage 3
Total number of membrane = 56

8.4 Post treatment

The treated effluent from the RO unit has the following characteristics

pH	. 4.5-5.0
Total dissolved solids	· 150-200 ppm
Hardness	· <5 ppm

The permeate from the RO unit is taken to a break pressure tank from where it is pumped to a degasser unit for the removal of free CO_2 generated during the separation process Blowing air through a packed media strips CO2. The permeate, stripped of CO_2, is collected in a treated water tank, where caustic is dosed for pH correction

The proposed flow diagram for Reverse Osmosis system is presented in figure 8.1

8.5 Cost Benefit Analysis

The capacity of the RO unit is 30M3/hr feed and 80-85% recovery The approximate cost of the RO unit of the above capacity is Rs 75 lakhs

The operating cost is Rs 11/M3 of water recycled This cost includes power, chemicals,consumables and membrane replacement cost.The details of operating cost is tabulated in Table-8.1

8.5.1 Benefits

1. 480 M3 per day of pure water of consistent quality
2. Zero discharge plant-Nil pollution
3. Saving in chemical cost when the water is used as cooling water makeup
4. Reduce the consumption of fresh water.

8.5.2 Disadvantage

120M3/day of high TDS water is rejected from the Reverse Osmosis unit. This water can be reused for domestic purpose.

FIGURE-8 1

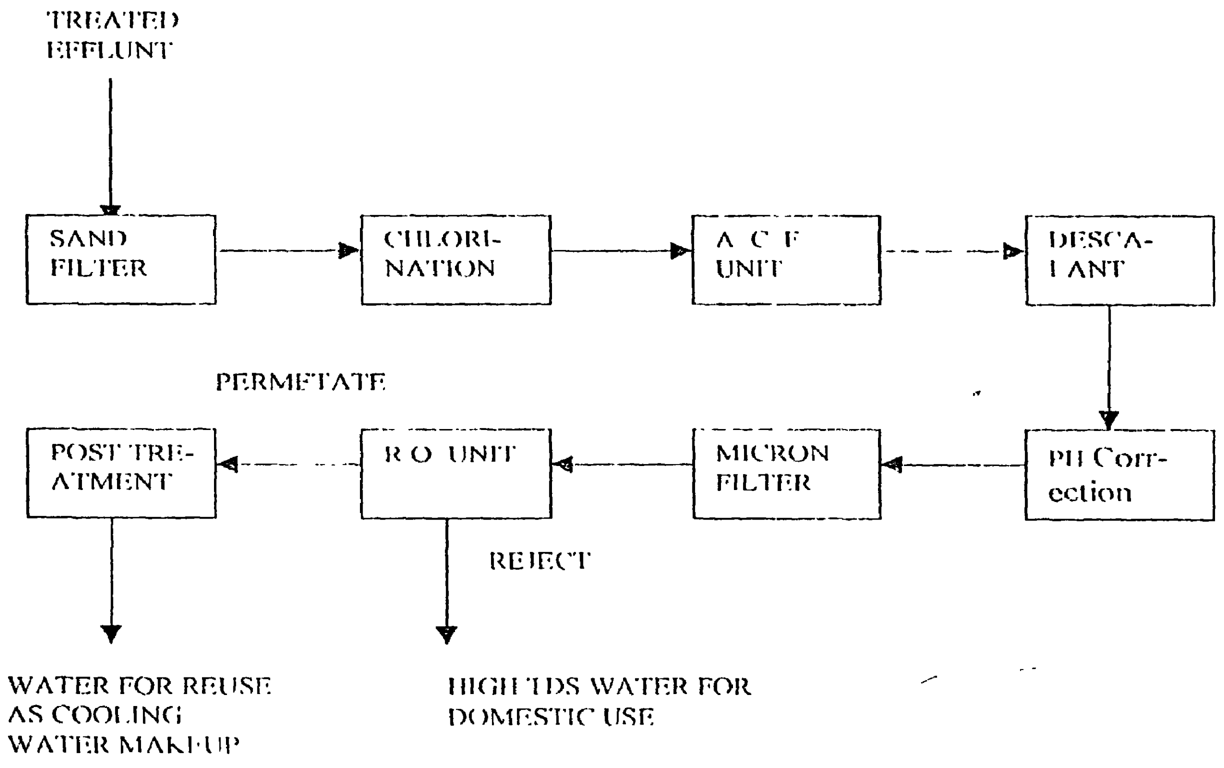

TREATED EFFLUNT
SAND FILTER
CHLORINATION
A C F UNIT
DESCALANT
PERMETATE
POST TREATMENT
R O UNIT
MICRON FILTER
PH Correction
REJECT
WATER FOR REUSE AS COOLING WATER MAKEUP
HIGH TDS WATER FOR DOMESTIC USE

TABLE 8-1

SL NO	Chemicals/Consumables	Quantity	COST Rs/M3 of product
1	Sodium hypo chlorite	0.45	0 04
2	Sodium hexa meta phosphate (SHMP)	0.6	1 00
3	Sulphuric acid	1.1	0.11
4	Caustic	4.8	1 04
5	Cartridge replacement (1 lot in 4 month)	1	0.46
6	Membranes (1 lot in 3 years)	1	5 05
7	Power	550KWH	2 85
	Total		10.55

CHAPTER-9

CONCLUSION

9.0 CONCLUSION

The main objective of this study is to carryout water and wastewater audit and the performance of the effluent treatment plant at HOC plant. This was conducted in a view to identify where to reduce the consumption of water and to reuse the effluent let out from the factory.

Based on the audit it was found that water used as gland cooling of pumps and compressors in the plant could be recycled and used in cooling tower This not only reduces the consumption of the fresh water but also reduces the consumption of cooling water chemicals used in cooling tower.

It was also found that around 600m3 of treated effluent is let out from the factory every day As per the performance study of the effluent treatment plant, the treated effluent let out from the factory, after proper treatment, can be reused as cooling water makeup

The major advantages of this project are listed below

1 It helps in conserving the water resources by minimising the consumption
2 It helps to minimise wastewater generation
3 Handling of the effluent becomes easier as the volume to be handled is considerably reduced
4 The efficiency and effectiveness of the effluent treatment plant is increased as the water is to be reused and the quantity of effluent to be treated is also reduced

5. There is an appreciable reduction in the consumption of chemicals needed for cooling water and effluent treatment.
6. The surface water is no more polluted by the treated effluent discharge.
7 The water cess paid for the fresh water comes down, as the quantity of intake is reduced
8. It helps to enhance the image of the organisation and has obvious advantage on implementation of ISO 14000.

CHAPTER—10

IMPLEMENTATION PROCEDURE

10.0 IMPLEMENTATION PROCEDURE

Having identified the areas where the water resource is being misused which could be recycled for reducing water consumption, there by conserving the same, the following procedure would be followed for implementation

1 The process effluent from Finished Acetone column aqueous, which is presently being drained in to effluent treatment plant, will be diverted in to ejector condensate As such, there is already a provision made in the existing set-up, which will be commissioned. for diverting the same. Here it will be used for washing the intermediate product and the washings will be treated in the primary treatment section before it is let out for secondary treatment.

2 The gland water, which is totally uncontaminated will be recycled back to the cooling tower for reuse, for which provision is to be made for recycling the gland cooling water As substantial quantity of gland cooling water is available, as estimated and given in the previous chapter, a considerable quantity of reduction in the consumption of make up water in the cooling tower The reduction in the consumption of cooling water chemicals is an added advantage

3 The vital activity in the implementation program, is the recycling of treated effluent in to the system, to achieve zero discharge of effluent As explained earlier, even though the effluent being discharged into the river is treated well with in the standard specified by Kerala State Pollution Control Board, the total dissolved solids (TDS) present in the treated effluent is the only objectionable pollutant for reuse in the system This treated water needs to be further treated for meeting the requirement of cooling water

4 The "Reverse Osmosis" technology has been identified to be techno-economically feasible proposal for treating the already treated effluent for the removal of TDS The design of the "reverse osmosis" system has been explained in Chapter 8. All the design parameters, operating conditions, operating equipment etc have been identified. A block diagram for the system is given in figure 8.1.A cost benefit analysis has been discussed in Table 8 1

The reverse osmosis system as per the design made will be implemented in the plant Samples will be collected and analysed for TDS periodically. The efficiency and effectiveness of the system will be studied and when the quality of water is found to be suitable for reuse in the cooling tower, it will be pumped to the cooling tower

5 Efforts will be made to minimise the wastage of water from all sources.

Programme on Energy, Environment, Resources, and Sustainability (PEERS) – 1997/98

Final Project Report

The status of river water quality: sources and nature of water pollution in Nepal

Submitted by
Mr Dev Raj Regmi

April 1998

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The status of river water quality: sources and nature of water pollution in Nepal

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THE STATUS OF RIVER WATER QUALITY: SOURCES AND NATURE OF WATER POLLUTION IN NEPAL

SUBMITTED BY :

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SUBMITTED TO :

PROGRAMME ON ENERGY, ENVIRONMENT, RESOURCE AND SUSTAINABILITY (PEERS)

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THE STATUS OF WATER QUALITY: SOURCES AND NATURE OF WATER POLLUTION IN NEPAL

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STATUS OF WATER QUALITY: SOURCES AND NATURE OF WATER POLLUTION IN NEPAL

- by Dev Raj Regmi

Abstract: *Nepal is endowed with abundant water resources that has potentials for supply of clean drinking water, irrigation and hydroelectricity. However, very small portion of such resources has been harnessed for its efficient use. Some tapped rivers have already begun to show strong symptoms of water quality deterioration.*

Sewage, organic components, surface water runoff, synthetic chemicals and heavy metals from industrial areas have been found as the major pollutants of waters in Nepal. Additionally, physical pollution due to presence of excessive silt and sedimentation poses a serious impediment in development of water resources.

Bagmati and Karra rivers carry the sewage of the Kathmandu City and Hetauda Industrial District respectively. These demonstrate typical examples of degrading water quality in the rivers of Nepal. Bagmati River, which used to have pristine water quality two decades ago, has virtually turned into an open sewer with uncontrolled city effluents. The Karra River is loaded with toxic waste chemicals that eventually contaminates one of the three major river systems of Nepal.

Rehabilitation projects for water quality improvement have been initiated in Nepal. These include measures such as control of water supply, prevention of soil erosion and sedimentation and regulation of waste water and sewer discharge. The Bagmati River in Kathmandu is being cleaned, which is expected to improve the water quality. Application of clean technology needs to be promoted in major industrial sites in Nepal. Strengthening of the institutional and legal frameworks, maintenance of environmental integrity, sustainable water use and water pollution prevention can improve the water quality of rivers in Nepal.

1. INTRODUCTION

This report is a product of a research work carried out in the field of water resources in Nepal. It is submitted to the Tata Energy Research Institute (TERI) towards the completion of the Programme on Energy, Environment, Resource and Sustainability (PEERS) Phases I to III. It is the PEERS programme which provided the necessary impetus to the study, because of which the report has been able to take off, but, it should be mentioned that, the final result is the outcome of a long interest in water resources and environment.

Water is the very essence of life. Good quality water is of paramount importance to human health and sanitation, ecology and environment, and the overall development of any society. Good quality freshwater sources are getting scarcer every day and the traditional concepts of this resource as a bountiful and plentiful free commodity has been reversed these days. It is a unitary resource that has to be utilised judiciously. Water is used for a multitude of activities and it is often reverted back to its natural surroundings grossly polluted and unfit for future use. Furthermore, the very fact that it is polluted, pollutes the ecology and the surrounding environment, and produces extremely harmful and hazardous consequences. The issue of water quality is of prime concern to all these days.

This report is presented with a brief country profile so that any reader shall be aware of the circumstantial setting of the water quality problem in Nepal and apprised of the various related factors that either aggravate the problem or minimise the effects. Methodology of the study carried out is then described in general. The report goes on further to describe the sources and nature of pollution of river water, institutional and legal framework for water quality protection and management, measures planned to rehabilitate the water quality of rivers in Nepal. The report has also addressed the issues of water pollution in Nepal from the aspect of the problems it faces in the development efforts of the country. The major impediment to water resources development in this regard, apart from the sanitation and environmental quality of water, is the physical pollution of water caused by sediments and siltation. This aspect has been, thus, dealt more elaborately. Finally recommendations for a better water quality management programme has been made.

2. COUNTRY PROFILE

The Kingdom of Nepal, lies in the South Asian Region, sandwiched between India and China. The high Himalayas form the border with the Tibetan Autonomous Region of the People's Republic of China to the north and the rest eastern, southern and western frontiers with the three States of India, namely, West Bengal, Bihar and Uttar Pradesh.

The land mass of the country is 147,181[1] square kilometers. It is elongated 800 kilometers from west-northwest to east-southeast with width varying between 140 to 230 (average 193) kilometers. Roughly 75 percent of the area is occupied by mountains and hills which contain intermittent valleys. Along the southern border lies a narrow plain, an extension of the Indo-gangetic Plains. The country is divided into following four physiographic regions.

- The Terai: The southern 10-40 km wide strip of fertile level land with elevation between 100 to 300 meter;
- A chain of the first foothills with elevation up to 1,300 m is known as Churia or Siwalik and are formed by the soft and erodible rocks;
- A rugged range of mountains with elevations between 1,500 to 3,000 m are known as Mahabharat Lekh; and
- The high Mountain Ranges above 3000 m come under Himalayan Range (There are ten of the world's 14 highest peaks including the highest mountain Mt. Everest of 8848 m).

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[1] HMG/NPC/CBS, 1995; Statistical Year Book of Nepal

Nepal occupies nearly one third of highest and youngest mountain portion of the active Himalayan Mountain System. The geological and geomorphic processes are still active. Owing to rugged topography, fragile geological conditions, high seismic activity, soft and thin soil cover and high intensity rainfall in short wet period, the mountains are vulnerable to land slides, erosion, sediment transport and deposition and other mass wasting phenomena leading to physical pollution of river water.

The Ganges and Bramhaputra rivers; which drain the Tibetan Plateau and the Himalayas, are among the largest sediment carriers[2] in the world. These rivers together drain an area of 104 million sq.km. and contribute 12 percent of the sediment flux in the world's oceans while contributing less than 3% of the water flux. They carry annually 1.6 and 0.8 billion tonnes of suspended sediments respectively.

Higher Himalayas and the Churia range are the two main regions which contribute most of the sediment load in the rivers. The deforestation in Churia Hills, where rocks are of loosely consolidated sediments derived from the erosion in the Himalayan rocks, has aggravated the problem. The problem of sediment load in Nepalese (Himalayan) rivers is mainly the result of geological process.

A recent study[3] found that out of the total of 10.19 million cubic meters of sediment deposited in reservoir of the Kulekhani Hydroelectric Station during March-December 1993, about 7.71 million cubic meters deposition occurred mainly during July 19-21, 1993 landslides and flood events. Similarly high sediments are carried into the main irrigation canals of Koshi, Gandaki and Mahakali during monsoon which thus results into substantial reduction of irrigating capacities with increased operation and maintenance costs.

2.1.1 Land Resources

Total land mass is 147,181 sq.km. About 2.641 million ha., 18% of the land, is estimated to be under cultivation[4]. The irrigable agricultural land is about 1.766 million ha. Out of this, 1.337 million ha. (76%) is located in the Terai and the remaining 429,000 ha. (24%) is river valleys, tars and leveled terraces in the Hills and Mountains.

About 412,000 ha. of land, currently classified as forest and grassland, could be brought under irrigation. Out of which 406,000 ha. is in the Terai and the remaining 6,000 ha. in the Hills and Mountains.

2.1.2 Population and Economy

The present population is estimated to be 21.1 million with a growth rate of 2.08 %. The potential labour force estimated to be 10.7 million (51%) for the 15-59 years of age. The literate population is estimated to be 32% .

The per capita Gross Domestic Product is identified to be US $ 215 for the FY 1996. It is estimated that the contribution of the agriculture sector (including fisheries and forest) in GDP is 40% and balance 60% comes from non-agriculture sector (industries, tourism, commerce, services and other sectors). In FY 1985, the corresponding contribution was 51 and 49%. The agriculture GDP growth is seen to be little higher than population growth. The agriculture sector provides employment to over 80% of the population. About 49% of the population are below the subsistence living conditions.

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[2] Shrestha H.M., 1996; Water Resources Development, unpublished WECS
[3] DHM/DPTC, 1993; Flood Assessment of Bagmati River and East Rapti River, 1994.
[4] Department of Irrigation, HMGN.

The transportation network is much to be developed. Most parts of the country is virtually inaccessible; only a small portion of the country is linked with the road network.

The country has a weak industrial base. The industries are located in urban areas and concentrated along the southern belt of the country, which has a better transport network and accessibility to the neighbouring country, India. The industries found are assorted kinds ranging from agro-based to product manufacturing. The major industries that have a direct bearing on water in terms of both consumption and pollution, are cement, leather and tanning, paper and pulp, soap and chemicals, sugar and khandsari, textiles, brewery and distillery, cigarette and tobacco, feed, iron and steel, resin and turpentine, plastics, polythene and PVC, paints, flour milling, solvent oil and vegetable ghee, jute, *kattha*, marble and magnesite quarrying. The nine districts that have major polluting plants are Kathmandu, Lalitpur, Bhaktapur, Morang, Sunsari, Parsa, Bara Makwanpur and Chitwan.

2.1.3 Climate

Rainfall varies from 1000 to 4000 mm per annum[5]. More than 75% rainfall occurs during four month monsoon period from June to September. The annual mean rainfall of the country is estimated to be about 1814 mm. About 64% of this precipitation goes as surface runoff. The remaining 36% is stored, either as snow in the Himalayas or as groundwater in the Terai.

2.1.4 Surface Water Resources

The rivers of Nepal drain the southern slopes of the Himalayas as well as some portion of the Tibetian Plateau and flow through gorges and valleys into the Terai plains and to the Ganges of Northern India. These rivers form the headwaters of the Ganges basin and contribute up to 41 per cent of the total run-off and 71 per cent of the lean flow. All the rivers have high seasonal fluctuations and their monsoon (May -September) waters account for 80-85 per cent of the total runoff.

The average annual runoff from the major and medium rivers is estimated[6] to be 5511 cubic meters which equivalent to total runoff of 224 billion cubic meters. It works out to a specific flow of 1,522,000m^3/sq. km. and a per capita availability of 11,200 cubic meters.

Although the abundant water is available, there is uneven temporal and spatial distribution influenced by the rainfall. The discharge from Nepal's river during monsoon accounts for 73 to 78% of the total flow of major/medium rivers. Thus, the full benefits from this resources can be exploited only by altering their regimes (flow regulation).

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[5] JICA, 1993: The Study on Nationwide Hydro-Meteorological Data Management Project

[6] Yogacharya K.S., 1996 - Assessment of Water Resources of Nepal and its Economic Value.

The glaciers and snow fields are important component of water resources. They occupy more than 15,000 sq. km., over 10% of Nepal's land area, and act as a seasonal natural reservoir of a vast quantity of water. Most of the rivers originate from this region and their perennial flow, especially the sustained base flow during the dry period, is maintained by the melt water from the glacier and snow fields.

Nepal's topography has a unique relief. The southern Terai plain is almost at sea level, while the northern frontier sharply rises to over 8,000 metres. In the upper and middle reaches, the rivers typically flow in narrow valleys with sharp falls. The valley configurations in the lower reaches, before the rivers emerge into the Terai plains, are favourable for storage schemes and multipurpose projects.

There are more than 6000 rivers whose total length exceeds 45000 kms. The rivers are classified into three grades, depending upon their place of origin. The first grade rivers are the Karnali, Gandaki (also known as Narayani) and Sapta Kosi rivers with their origin in the snow and glaciers in the Himalayan region (including Tibet Region in China). The second grade rivers are the Babai, West Rapti, Bagmati, Kamala and Kankai. These rivers are fed by groundwater including springs. These rivers have high seasonal fluctuation compared to the first grade rivers. The third grade rivers are the Bering, Bakra, Balan, Khutti, Patharaiya, Lal Bakaiya, Ratu, Sirsia, Manusmara and Banganga. These rivers have their origins in the Siwalik range and are mostly rain-fed.

Economically the most important rivers are Koshi, Gandaki, Karnali and Mahakali. The other major rivers include Kankai, Kamala, Bagmati, Tinau, West Rapti and Babai. A summary of the main features of the major rivers in Nepal is given in Table 1 and described below.

Table 1. Main features of major rivers in Nepal

Country/ River	Location	Drainage Area Km^2	Length km	Mean Annual Discharge* m^3/sec
Mahakali	Far Western Region & boundary with India	15,260 (Total) 5,400 (In Nepal)	233	557
Karnali	Far and Mid Western Region	44,000 (Total) 41,360 (In Nepal)	550	1,398
Babai	Mid Western Region	3,252	190	72
West Rapti	Mid Western Region	6,215	257	125
Narayani	Western & Central Region	34,960 (Total) 31,726 (In Nepal)	451	1,767
Bagmati	Central Region	3,681	163	214
Kamala	Eastern Region	1,786	117	75
Kosi	Central & Eastern Region	60,400 (Total) 27,863 (In Nepal)	534	1,566
Kankai	Eastern Region	1,317	108	73

*estimated for Nepal India Border

Source: Nationwide Hydro-Meteorological Data Management Project, 1993, JICA and other sources.

The **Mahakali river** is 233 km long, having its origin in Api Himal, is an international river located on the western border of Nepal with India. The total catchment area is about 15,260 Km^2 of which about 5,400 Km^2 (35 per cent) lies in Nepal. The snow-covered area in this basin is 800 km^2. The average annual flow of the river is about 557 m^3/s. The observed maximum and minimum mean daily discharges are 4,752 m^3/s and 89 m^3/s respectively.

The Governments of Nepal and India have recently signed the new Treaty on Integrated Development of Mahakali River including Sarada Barrage, Tanakpur Barrage and Pancheswar Project (1996), as bilateral cooperation project for the utilization of the water resources of this river. The Sarada Barrage was constructed by India during the 1920s which reportedly irrigates about one million hectares in India and a few thousand in Nepal. The Tanakpur Barrage located upstream of the Sarada Barrage was also built by India and has an installed capacity to develop 120 MW of hydropower. The proposed Pancheswor high dam has been estimated to yield 6,480 MW of hydropower and provide irrigation as well as flood moderation benefits.

The **Karnali river**, one of the three major river systems in Nepal, originates from the south of Mansarovar and Rakas lakes located in China (Tibet). The river has a total drainage area of about 44,000 Km^2 of which 2,640 Km^2 lies in China and the remaining 41,360 Km^2 in Nepal. The snow covered area is about 12,700 Km^2. The total length of the main stream of Karnali river is 550 km of which 435 km lies in Nepal and the remaining 115 km in China. Bheri, Thulighad, Seti, Lohare khola, Tila, Mugu Karnali and Dojamchaur khola are the main tributaries of Karnali river. The river is called Ghagra in India and flows to the Ganges.

On the basis of the records of 32 years (1962-1993) at the Chisapani gauging station, the average annual daily flow of the Karnali river is found to be 1,398 m^3/sec. varying from the minimum of 214 m^3/sec to the maximum mean daily flow of 14,700 m^3/sec. This river basin is one of the least developed and remote area in Nepal. There is a tremendous scope for hydropower generation and high irrigation potential.

The **Babai river** originates from the Churia range in Deukhuri district. It drains the Deukhuri valley and flows due south to the plains. It joins Ghagra (Karnali) river in India. It is 190 km long and has a catchment area of 3,252 Km^2. The average annual flow of Babai river is 72 m^3/s. The maximum daily average discharge is 6,120 m^3/sec and the minimum, 4 m^3/sec.

The **West Rapti river** with its two main tributaries, Jhimruk Khola and Mari Khola, originates from the Mahabharat range in Piuthan and Salyan districts. The total length of the river is about 257 km and the drainage area is 6,215 Km^2. The average annual daily flow is 100 m^3/sec (records of 1976-1990) at Bagasoti. The maximum mean daily discharge is 1,690 m^3/sec and the minimum is 8 m^3/sec.

The **Narayani river** basin drains the central part of Nepal. Kali Gandaki river flowing out of the snow covered Mustang Bhot Himal, joins the Trishuli river at Devghat, and onwards from it, the river is known as Narayani. It is also known as the Sapta

Gandaki river. The Budhi Gandaki, Marsyangdi, Seti and East Rapti are the major tributaries of this river.

The total catchment area of this basin is 34,960 Km^2 out of which 31,726 Km^2 lies in Nepal. The area covered by snow in this basin is about 6,900 Km^2. The average annual daily flow of Narayani river is 1,767 m^3/sec, varying from a maximum of 22,500 m^3/sec of mean daily flow to the minimum of 169 m^3/sec. This river system with Kali Gandaki as the main stem is 451 km long. It is the biggest river system, in terms of gross discharge, with the annual surface run-off of 50 billion m^3 at the gauging site in Narayanghat.

The river has immense potential for hydropower and irrigation. The Marshyangdi and Trishuli rivers have been utilised for 104 MW of hydropower generation. The Gandak Barrage constructed on the Narayani River at Nepal-India border under an agreement between Nepal and India provides India with an irrigation benefit of more than 1.7 million Ha. of land in Uttar Pradesh and Bihar States, and provides Nepal with an irrigation benefit of 45,400 Ha..

The **Bagmati river** originates from the southern face of Shivapurilekh in Kathmandu. It drains an area of 3,681 Km^2 including the Kathmandu valley and is 163 km long and joins the Ganges in India. The average annual flow of Bagmati river is 214 m^3/s. The maximum is 4,050 m^3/sec and the minimum 5.8 m^3/sec. Manahara, Bishnumati, Kulekhani, Kokhajhor khola and Marin khola are the major tributaries of Bagmati river.

The river drains Kathmandu Valley. The river is under serious degree of pollution with large concentrations of toxic and organic contaminants in the upper reaches. It is used extensively for irrigation in the downstream stretches as it emerges into the plains. The only storage project of the country, Kulekhani Storage Hydro-electric project (installed capacity 92 MW) lies in this catchment area. This project has suffered extensively due to sedimentation of the reservoir which has compelled the relocation of the intake tunnel inlet to a higher elevation thus reducing the active storage volume.

The **Kamala river** originates in Sindhuli district in the upper reaches of Mahabharat Range and flows to south. The drainage area of Kamala river is 1,786 Km^2 and is 117 km long. The flow records at Timnai Chisapani show that the average annual daily flow of 75 m^3/sec, with the maximum and minimum daily averages of 395 m^3/sec and 1.1 m^3/sec respectively. This river has been extensively utilized for irrigation and there is a shortage of water in the dry season. There is an attractive project viability for drawing some water into this basin from the Sunkosi river (Kosi Basin), and utilising for hydropower generation and reliable irrigation.

The **Kosi** is the largest river basin of Nepal located in the eastern part of the country. The total catchment area of the basin is 60,400 Km^2. Out of which only about 46 per cent amounting to 28,140 Km^2 lies in Nepal, the rest lying in the Tibetian autonomous region of the Republic of China. The main tributaries of the Sapta Koshi river basin are Indrawati, Tamakoshi, Likhu, Dudh Koshi, Sun Koshi, Arun and Tamur. The Arun is the longest tributary with a length of 513 km, which makes the Sapta Koshi river system 573 km long till the Nepal border with India.

The observed average annual daily flow of Sapta Koshi river is 1,498 m^3/sec varying from a minimum of 173 m^3/sec to the maximum of 9,450 m^3/sec mean daily flow. The snow cover area in this basin is estimated to be around 6,780 Km^2 with a number of glacier lakes. The total average annual flow of Kosi river is 1,566 m^3/s as it emerges out of Nepal.

All these rivers have high gradient at upper reaches above 1,000 m elevation. There are some excellent hydropower generation sites in this river basin. Their total capacity and annual energy are estimated at 10,900 MW and 56,546 GWh respectively. The major use of the water resources, however, at present, is for irrigation. The Kosi Barrage, built by India under the Kosi Agreement, provides Nepal with 50 per cent of the power generated from a 6 MW Kataiya power house and water to irrigate 21,000 Ha.. India is irrigating about 1.33 million Ha.. Another 68,000 Ha. irrigation project, Sunsari Morang Irrigation Project is also served by this river.

The river is loaded with excessive silt and sediment during the monsoon flows and is also known as the "sorrow of Bihar" in India through which it used to flow repeatedly shifting its course washing away fertile lands. Presently the river has been extensively trained at both banks in the plains.

The **Kankai river** originates from the Chintapu hill in the Mahabharat range in Ilam district. It drains 1,317 Km^2 and is 108 km long. The average annual flow of Kankai river is 73 m^3/s. The river has also been harnessed for irrigation as it enters the Terai plain.

3. OBJECTIVE OF THE STUDY

This study is carried out to fulfill the aim of the Training Programme on Energy, Environment, Resource and Sustainability (PEERS) as mentioned before. The primary objective of the study is to review the status of water quality, the sources and nature of water pollution in Nepal. The water bodies in Nepal is predominantly river water, thus stress has been given to the pollution of rivers. The specific objectives of the study are mentioned below.

- To briefly assess the water potential of Nepal,
- to identify in general the causes of pollution and issues in water quality management,
- to demonstrate the water quality of rivers in Nepal,
- to identify the institutional and legal framework for water quality protection and management,
- to determine the measures planned to rehabilitate the water quality of the rivers of Nepal,
- to suggest a comprehensive approach and a strategy for water quality management, and
- to make recommendations for a better water quality management.

The exercise has been limited to the extent that it was carried in addition to the primary official duties carried out by the author for fulfillment of the requisite for the PEERS Training Programme and thus there could be gaps and lacunas that need to be further addressed.

4. METHODOLOGY

As mentioned above, this study report is an outcome of the participation in the Training Programme on Energy, Environment and Resource Sustainability (PEERS) from its Phase I to the final Phase III organised by the Tata Energy Research Institute (TERI), New Delhi, India.

The methodology carried out is outlined as follows:

- Literature review
- Field Survey
- Interview with local people
- Personal communication with concerned officials

The methodology employed in the study is primarily that of data collection, identification and complilation of the various information and reports available in the related areas of the study for the preparation of this report. These were studied and reviewed to draw out the relevant material for the report. Identification of the various institutions and organisation engaged in the aspects of water quality, meetings with the concerned officials and individuals of the related institutions; assimilation of the information, data and reports; analysis and synthesization of the collated information have been also done.

The study has been supported by a numbers of field visits to the sites referred to in the report. These were undertaken to get the first hand experience of the situation and the problems encountered. Only a limited primary data was generated for the study. Thus the study is based on the secondary data and information available.

The study was carried out to meet the set objectives. For this the information was collected to address the following broad areas.

- The physical parameters of the water bodies: e.g. discharges, catchment area, land use pattern, siting of urban or industrial centres, etc.
- Sources of pollution of water bodies,
- Nature of pollution of water bodies,
- Impacts of the pollution,
- Institutional, administrative settings and their efficacy, and
- Recommendations for improvement.

The study has emerged strong in the nature and sources of pollution of water bodies but it has been difficult to quantify the impacts of pollution. It was realised that this issue would require much more intensive study, greater resource and time as only a limited information was available.

The major reports, books and periodicals referred to and studied have been listed in the list of reference at the end of this report, but there certainly could be more due to the number of varied sources of information and the bits and pieces of information that have been collected not only during the study period but also during the period in which the author has been in association of this subject area. The Documentation Centre of the Water Energy Commission Secretariat housed in the Ministry of Water Resources has been extensively used for the study.

The sequential progress of the study period was differentiated into the following phases leading to the final preparation of this report.

Phase I: Identification of the objective of the study and the area of the study. Various possible areas of study were thought of and their relative merits determined. After much deliberation and in consultation with the attached supervisor/guide at the TERI, the field of water quality was selected. The study was directed to identify the situation of the water quality problems in Nepal and determine the activities undertaken to carry out its remedy. The skeletal outline of the report was first prepared and areas to be addressed in detail outlined. This led to the identification of the type of data and the information required and development of a primary questionnaire.

Phase II: The actual collection of data and information, field visits, interviews with the related individuals, officials and the consumers were carried out in this stage. The data and information that were gathered during the author's association with the development efforts in Nepal, and the chequered career across various fields were extensively relied upon. Extensive review of the associated literature was also carried out to draw out the necessary information. These led to scores of notes and raw data.

Phase III: The raw data and the information collated were further scrutinised, verified where possible, analysed and synthesized in to a coherent form. This was further transformed in to a draft report. The draft report was further revised and finalised as the final study report. This report is the final outcome of the study.

During the course of the study, the Training Programme on Energy, Environment and Resource Sustainability was also attended in parallel. This enabled the author to streamline the subject and carry out the study in a better way. The advise of the supervisor/guide at the TERI was also helpful.

5. IDENTIFICATION OF WATER QUALITY PROBLEMS

There exist definite links between water quality, water quantity and land use, and it is necessary to identify water quality problems in the context of integrated land and water resources management. Water quality is inherently linked to water quantity. The parameters used to measure water quality are defined in terms of the polluting agent existing in a certain specified volume of water, thus, the quantity of water is an important aspect tied up with water quality. Human and natural activities create point and diffused sources of pollution and change the runoff regime, adversely affecting the quality, quantity and seasonal availability of water. Water resources developments also have adverse impacts, to varying degrees, depending on the nature of development in any given area.

Pollutants occur in rivers when substances are added to the environment, causing detrimental alteration to its physical, chemical, biological or aesthetic characteristics. Pollutants are either natural or foreign substances discharged in excessive amounts. Harmful substances in rivers can occur as a result of natural as well as human developments.

In general terms the main pollutants of concern are sediment, nutrients, pesticides and fertilisers, salinity, and disease causing bacterial and viral infections, organic material and heavy metals. The relative importance of these varies widely depending on the particular circumstances in each river system. In some cases, where specific pollutants are not a concern in their own right, they are still a concern in terms of their association with other pollutants. The main possible pollutants and the manner in which they pollute are briefly described below.

5.1 General Causes of Pollution

Organic pollutants: The major pollutants produced by human activities are substances which have comparatively little direct harmful effect on river water quality. Relatively non-toxic animal and vegetable wastes such as sewage, food processing wastes and other wastes in certain limited quantities can be beneficial in some waterways by acting as fertilizers to stimulate plant and animal growth. However, in excessive quantities their secondary effects are extremely harmful.

Organic wastes are chemically complex but consist essentially of carbohydrate and proteinaceous substances which provide a food source for micro-organisms to effectively metabolise these substances. Organic discharges can therefore result in the depletion of dissolved oxygen content in streams where the rate of depletion is greater than the rate of replenishment.

A more advanced state of pollution occurs when the dissolved oxygen content drops to zero and micro-organisms which do not require free oxygen become active. The major products of the anaerobic process are generally methane and carbon dioxide, with lesser amounts of ammonia, hydrogen sulphide and a variety of other organic and inorganic compounds. Some of these compounds are poisonous and have a strong nauseous odour. Streams exhibiting such strong odours are almost invariably heavily contaminated. The effects of pollution by organic wastes depends mainly on the volume and strength of the discharge and the volume and flow rate of the receiving water. In a flowing river, a number of different aquatic environments and communities of aquatic organisms are usually created, which are essentially related to dissolved oxygen content.

Salinity: Salinity occurs when saline groundwater rises to surface waters as a consequence of activities such as irrigation, tree clearing and mining, after concentration through evaporation, effluent from cooling systems water, paper mills and other industrial processes. Salts occurring in many waterways are undesirable for many uses. Most salts, once dissolved in water, are not removed by natural processes, and with present available technology their removal is financially prohibitive. Damage can be caused by salts at very low concentrations, even well below the taste threshold.

Nutrients: In agriculture, nutrient deficiencies are rectified with the application of fertilisers which increase crop yields. In addition to nutrients such as nitrogen and phosphorous, many other substances are needed in varying quantities. Rivers and other waterbodies are maintained by runoff water from surrounding areas. Contained in this water are plant nutrients, silt and other materials leached and detached from soil and rocks. Over time, nutrients and silt may accumulate in streams. Nutrient-enriched waters demonstrate symptoms of stress, such as the proliferation of algal blooms. Algal blooms can release highly toxic substances into the water.

Changes in the chemical characteristics of river water, due to factors such as evaporation, addition of runoff from the surrounding catchment, etc. can result in the release of nutrients from sediments. Eutrophic waters can generate conditions similar to those due to pollution by organic matter in relation to animal and vegetable wastes. Thus, in addition to DO depletion, there can high bacterial activity and changes to the aquatic ecosystem. The addition of nutrients can, in some instances, have beneficial effects on waterways due fertilisation and increased productivity. However, in many cases, changes towards eutrophic conditions have had detrimental effects. In excessive cases conditions are produced which are unsuitable for fish and other aquatic organisms. Toxic blooms put the health of humans and other animals and organisms at risk.

Sewage: The discharge of untreated or primary treated sewage into an aquatic area causes deoxygenation and during this process, nutrient salts are released. Secondary treated sewage has had the biochemical oxygen demand substantially removed during treatment but contains the same nutrient salts as would be released by untreated sewage.

Bacteria: Pathogenic bacteria, such as E-coli, are a problem where sewage effluents intensively grazed land or areas which have concentrated aquatic life drain into waterways used as domestic water supplies, recreational and irrigation uses.

Runoff: Storm water runoff in agricultural and urban areas can contain significant concentrations of nutrients. Overflow from septic tanks and household wastes from sinks, laundries, baths, etc. are major contributors to the nutrient content.

Synthetic Chemicals: Pesticides are used to control insects, fungi, weeds, animals and pests. Insecticides and weedicides are probably used in the greatest quantities. When pesticides are applied in a blanket format, they are readily washed into rivers via wind and water. Pesticides have a range of effects in aquatic ecosystems. The persistence of pesticides in an important consideration from both an environmental and economic viewpoint. Persistence in the environment means that there is time for accumulation or biomagnification to occur leading to the appearance of comparatively high concentrations in organisms.

The builders used in detergents to enhance the activity of the surfactant are usually polyphosphates. Phosphate occurs in crude sewage and survives treatment in a sewerage plant. Phosphates in detergents are a major source of phosphate in sewage. Detergents originating in households are often discharged into streams with waste water. Synthetic detergents are more effective in hard water and less readily degraded than soap made organically. Rivers may at times develop masses of foam as a result of the release of detergents into waterways.

Synthetic chemical wastes are generally byproducts of an industrial process, or chemicals contaminated or exhausted by use. They are very diverse in chemical type and environmental impact. Offending materials include cyanides and heavy metals from metal processing, chromium materials from tanning, and acids and bases from manufacturing plants. Each waste produced usually contains a complex mixture of chemicals. The pH is an important environmental property of many liquids including natural and waste water. Water pH affects a number of aspects of aquatic ecosystems such as growth rate and reproduction. Many chemical substances are highly toxic to fish. Illegal dumping of chemical wastes into municipal sewerage systems has occurred regularly, meaning that many chemical substances pass through river systems with little alteration.

Suspended solids, turbidity and sediments : Sediment, both suspended and deposited, is a natural component of waterways. Excessive concentrations of silt may result when construction, mining, agriculture, dredging and other similar operations including those due to the natural causes of erosion and mass wasting phenomena occur. Soils on floodplains and sediments along lowland river courses are often composed of finely divided particles which remain suspended in water for long periods of time. Land clearing, cropping, grazing, road building and urban development add significantly to natural suspended sediment levels through erosion. This is exacerbated by storm events leading to the export of sediments from catchments. High levels of sediments in rivers reduces light penetration necessary for photosynthesis and the maintenance of submerged vegetation. High levels of suspended sediments are harmful to aquatic flora and fauna. Suspended sediment pollution if exceeding a certain limit renders the water bodies unsuitable for effective use. It has been seen to be a major problem in harnessing of water, whether it be for irrigation, hydropower, industrial or municipal purposes.

In addition, in reservoirs, layers of standing water bodies accumulate plant detritus which may cause turbidity and decrease dissolved oxygen in water at lower depth.

Thermal pollution: Water temperature regulates many ecological processes. Many aquatic species cannot exist if temperatures are not suitable for reproduction, growth of food, spawning, etc. Thermal pollution often results from the discharge of cooling water circulated through industrial or power generating plants. Although water may be used and discharged in a chemically unaltered state, the temperature of the water has often been changed. Also in deep reservoirs, where the outlets or sluices are located below, the cooler layers of water at the bottom are released as the heated or warm water rises up to the surface. Water temperature does not return to normal river temperature for many kilometers downstream and affect the water quality.

Petrochemicals: Petroleum oils are a significant issue. Oil slicks, and tar residues reach waterways through the extraction, transport and use of petroleum products. Although this problem is more commonly associated with those who handle petro-chemicals in bulk, it is still an issue for river water quality.

Heavy metals: Metals can exist in water and organisms in a wide variety of chemical forms and combinations with other materials. For example, in water as free metal ions, organic complexes and compounds and associated with colloidal or particulate matter, usually absorbed onto the surface. The biological properties and availability of metals vary considerably depending on its chemical form. The concentrations of heavy metals in waters throughout the world vary according to natural factors such as water runoff patterns and occurrence of ore bodies and pollution factors such as location of industry and urban complexes. If a metal is present in sublethal concentrations in water, an organism may absorb it through the gills, food or body surfaces. If the rate of loss is slower than the rate of absorption, accumulation will occur in body tissues. The possibility of food chain biomagnification presents a problem for aquatic and human health.

5.2 Issues in Water Quality

The global issues in water quality are described below as stated by Earthwatch Global Environment Monitoring System, WHO/UNEP, Report on Water Quality[7]. These are found to be very pertinent to the water quality situation in Nepal and are presented below.

- *Quantity Vs Quality:* Water Quality and Quantity are intrinsically linked. The quality of water is very much related to the quantity of water in which the pollutant is dissolved or suspended in. The quantity available for consumption also affects the quality of water. Sustainable development of water resources cannot occur without recognition of user requirements for water of specific quantity and quality.

- *Drinking Water:* The provision of good quality drinking water takes priority over all other uses. The human right to have access to safe drinking water in quantities and of a quality to meet basic needs has been recognized by all as an area of prime concern.

- *Health Impacts:* Water-related diseases are still a major health problem. Diseases caused by microbial contamination of water supplies or transmitted by water-associated vectors are the greatest problem for health care in developing countries.

- *Chemical Safety:* Synthetic chemicals pose the most ubiquitous and persistent threat to aquatic ecosystems. Chemical products, particularly pesticides, and wastes affect many beneficial water uses. These substances are often highly toxic, non-biodegradable and bioaccumulated.

- *Groundwater:* Groundwater is a crucial aquatic resource. They provide a vital support for life for many people, but are increasingly threatened by over-exploitation, salinization and long-term, cumulative contamination.

- *Law Enforcement:* Effective regulatory enforcement mechanisms are prerequisites for water quality management. Water pollution can only be controlled on the basis of comprehensive legislation and through competent implementing institutions.

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[7] WHO/UNEP, Earthwatch, Global Environment Monitoring System, WHO/UNEP Report on Water Quality, Progress in the Implementation of the Mar del Plata Action Plan and a Strategy for the 1990s.

- *Public Awareness:* The involvement of the public is essential for policy implementation. The importance of good quality water for human health and for economic development should become common knowledge and relevant policies must be supported by broad public consensus and political will.

- *Problem Assessment:* Reliable water quality data bases are indispensable. Assessment of water quality and forecasting of global impacts on aquatic ecosystems demand high quality and continuously evolving monitoring networks and information systems.

- *Ecosystem Integrity:* Fresh waters must be considered as a single aquatic ecosystem. Rivers, reservoirs, lakes and ground waters must be managed in an integral fashion, taking account of climatic, hydrological and socio-economic influences.

- *Basin Framework:* Water quality should be managed within the drainage basin. This provides the most practical hydro-geographic unit within which the quality of rivers, lakes, reservoirs and aquifers can be effectively controlled.

6. Sources And Nature Of Pollution In Rivers Of Nepal

6.1 Status of Water Quality in Rivers

The sources of pollution to the fresh water is in the from of industrial and municipal point sources, agriculture, human activities and natural causes resulting in erosion and sedimentation of the hill country. The general causes of pollution have been described in the previous section. The overall extent of anthropogenic pollution is comparatively very low due to the inaccessibility of the hinterland and low level of industrialization. Nevertheless, alarming cases of gross pollution of rivers are evident in urban centres and industrial locations.

The traditional agricultural practices of the marginal farmers of burning and tilling highly unstable slopes, overgrazing pasture lands in the hills, deforestation and denudation of the geologically young and active topography have not only resulted in mass wasting and loss of valuable top-soil, but also rendered the water conveyance/storage systems inefficient requiring extensive preventive and expensive remedial measures. It has also caused damage to valuable land and caused disastrous floods.

The bio-chemical and/or toxic pollution of waterways is mainly limited to those rivers that pass along or through cities and towns. Individual septic tanks, soakpit systems and some pour flush latrines and pit latrines exist in urban areas (the pollution of groundwater due to the leachate does exist but has not yet been quantified) with the majority of effluent discharging into municipal drains, rivers and agricultural lands. Ultimately, discharges reach rivers, contributing significantly to poor water quality.

Sewage treatment before release is almost non-existent. There is no sewerage system in any of the municipalities of Nepal except for Greater Kathmandu (which has non-functioning stabilisation ponds except for the Kodku Waste water Treatment Plant at Lalitpur which is in operation) and Bhaktapur.

With the lack of detailed monitoring of the pollution of rivers, evaluation of the type and extent of pollution is impossible. Detailed quantitative analyses of physio-chemical parameters of waste water and pollution loads and subsequent impacts on receiving waters are of prime importance.

A study conducted in 1994 indicated that Kathmandu Valley accommodates approximately 50 per cent of the total industries in Nepal. Approximately 76 per cent of industrial waste water in Kathmandu Valley is contributed by carpet, dairy, textile, leather, soft drink and alcohol, pulp and paper, sugar, vegetable oil and iron/steel industries. The industrial pollution load scenario in Nepal shows that the Eastern Development Region supports the most polluting industries and the Mid-Western Region has the least polluting industries.

6.2 Bagmati River

While sewage and industrial wastes are the most visible causes of contamination along the Kathmandu section of the Bagmati river, non-point sources such as air pollutants, pesticides and fertilizers also contribute to the contamination. Comprehensive studies on the pollution of this river have been conducted by DISVI in 1988, in cooperation with RONAST, WECS/MOWR (NESS, 1997) and several other agencies including DHM (1992-95), NPC/IUCN, etc.

The Bagmati River in Kathmandu is regarded as 'excessively polluted' with BO levels above 10 mg/l. High values of BOD, upto 450 mg/l, are reported in Kathmand industrial effluents[8], whereas the national Nepal Standards limit for effluent discharge 30 mg/l BOD.

The amount of non-point sources waste loading in the upper Bagmati basin maximum followed by the Terai in the lower Bagmati basin. The total amount of was load per unit area is depicted in Table 2. Total loading of industrial effluents other poi sources of pollution in the upper Bagmati basin is estimated at 1150 ton/yr. of BOI equivalent, whereas in the other sub-basins it is negligible (NESS, 1997).

Dissolved oxygen (DO) content in the Bagmati river is critical and found to t extremely low within the Kathmandu Valley stretch. As the river passes through the ci core area, the DO content diminishes to less than O.5 mg/l and no fresh water aquatic li is expected to survive in such an environment.

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[8] **M. B. Gewali, R. Amatya, et al., 1994; Chemical Analysis of Industrial Wastewater from Kathman Valley (Proceedings of International Seminar on Water and Environment, ed. R. Chitrakar, Nepal Chemic Society, Kathmandu)**

Table 2: Total waste loading pattern in different sub-basins of Bagmati River[9]

	Non-point source of pollution load (Kg/Ha./yr.)						Point load (ton/yr.)
S.No	Basin	Sub-basin	BOD_5	N_2	P_2O_5	K_2O	BOD_5
A.	Upper Bagmati	Upper Bagmati	738.48	351.48	106.10	61.16	1150.00
B.	Upper Middle Bagmati	Kulekhani Khola	340.14	79.21	26.30	10.07	Insignificant
		Khani Khola	418.27	97.03	32.65	12.23	
		Kokhajor Khola	262.38	63.49	22.00	8.81	
C.	Lower Middle Bagmati	Marin Khola	146.77	48.84	13.40	7.32	Insignificant
		Chaura Khola	287.84	71.39	23.78	9.35	
		Chiruwa Khola	484.89	112.91	37.91	14.50	
		Kayan Khola	36.56	17.13	3.14	2.78	
D.	Lower Bagmati	Terai	404.60	189.04	46.79	23.69	Insignificant
Average waste load in the Bagmati Basin			346.66	114.73	33.12	16.66	-

DISVI (1988)[10] classified the river into distinct zones according to water quality class as determined by the extended biotic index (EBI). The least polluted water is classified as Class I and the most polluted as Class V. Various chemical parameters such as COD, BOD, NH_3, PO_4, NO_3, Cl and electrical conductivity (Ec) have also been examined to determine the river water quality with similar results to those using EBI. Table 3 summarizes the findings of the various water quality studies on the Bagmati River system (NCS, NPC/IUCN, 1991).

The river quality of Bagmati River varies with the seasonal variation. Pollution load is the highest in summer, while it decreases in winter and during the rainy season. The Bagmati River and its tributaries maintain good chemical and biological quality until they the urban areas.

The extent of toxic pollution in the River Bagmati can be estimated by studying the extent of pollution by carpet industries. Untreated effluent from these industries are discharged into rivulets, rivers, nearby fields, drains and to municipal sewers. A study[11] indicated that of the 335 registered carpet industries, 150 consume approximately 6.1 million litres of water per day (MLD) and generate 5.5 MLD waste water. The biochemical oxygen demand load into the local rivers is 1.1 ton per day whereas the dry season flow of these rivers hardly exceed 3 m^3. Heavy metals like chromium, cobalt, nickel and zinc are also present in the effluent.

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[9] NESS/WECS, 1997; Environmental Study of the Bagmati Watershed and Mitigation of River Pollution

[10] DISVI, 1988; Pollution Monitoring of the Bagmati River - Preliminary Report

[11] M. B. Gewali, R. Amatya, et al., 1994; Chemical Analysis of Industrial Wastewater from Kathmandu Valley (Proceedings of International Seminar on Water and Environment, ed. R. Chitrakar, Nepal Chemical Society, Kathmandu)

Table 3: Water quality of the Bagmati River system

Sample Site	Distance of Sample from the river source	Water Quality Class (EBI)	Parameters exceeding WHO standards
Bagmati River			
Sundarijal	7 Km	I	None
Gokarna	15 Km	I	None
Pashupatinath	20 Km	II	COD, PO_4
Thapathali	25 Km	III	COD, NH_3, PO_4 ; Conductivity (Ec)
Sundarighat	28 Km	V	All parameters
Chobhar	31 Km	Fluctuates	COD, NH_3, BOD
Khokana	35 Km	III	COD, NH_3
Tributaries			
Manohara River at Phulbari		II	None
Dhobi Khola at Baneshwor		III	BOD, COD, NH_3, and Conductivity (E
Bishnumati River at Kalimati		IV - V	All parameters

Source. DISVI (1988) and others

6.3 Use of Pesticides and Chemical Fertilizers in Agriculture

Agricultural runoff is a significant non-point source of pollution, degrading the environment through contamination of surface and ground waters which are used as sources of drinking water. Though the extent of use of these chemicals in agriculture is comparatively lesser than that in other developed countries, problems of unwarranted use are on the rise. A study[12] carried out in 1990 estimated that the phosphorous load from rural and agricultural areas contributing to the eutrophication of Phewa Lake in Pokhara amounted to 3 804 kg every year while the contribution from urban domestic waste amounted to 6 931 kg annually.

Chemicals in use in Nepal are agro-pesticides, namely, organochlorins, organophosphates, carbamates, synthetic pyrethroids, fungicides, fumigants, rodenticides and herbicides. Chemical fertilizers are being used more widely while insecticide use is on the decline. There are reports of uncontrolled dealing of pesticides along the open border with India. There is continued and persistent use of organochlorin pesticides (DDT, BHC and Aldrin) that are banned in many areas which is a matter of serious concern.

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[12] HMG/NPC/IUCN, 1994: A Study on Pesticide pollution in Nepal

6.4 An Example of Industrial Pollution of Water in the Hetauda Industrial District (HID)[13]

The Hetauda Industrial District (HID) established in 1962 occupies an area of 144 Ha. and is the largest industrial district in Nepal. At present, there are 32 industries, of which 28 are operational, 4 have been closed and 10 are to be built. HID employs 2 546 people and consumes 779 000 m^3 of water per year (60% supplied by HID management and 40% by Hetauda Textiles, the largest consumer which sources water from its own well and the Karra River). Approximately 70 per cent of water used is discharged as waste water, mainly contributed by food and beverage, textile, leather and chemical products. Besides HID, the Hetauda Cement Factory also contributes to the pollution of the Karra River as a result of liquid waste discharges.

Industrial and municipal waste water containing toxic chemicals is discharged without any treatment, to unlined storm drains and sewers which ultimately enters Karra River. Industrial and hazardous solid wastes are either buried, burnt or flushed into drains. Toxic chemicals and wastes are spread on the ground or poured into wells. Sometimes they are mixed with household wastes and sold or dumped elsewhere.

As liquid and solid hazardous wastes are not properly treated and managed, the adverse impact on water courses, particularly the Karra River is tremendous. Additionally, pollution of groundwater is certain. It has also been reported that waste water from HID is used to wash vegetables and irrigate fields by locals, which can lead to serious health implications. The characteristics of the waste is summarised in Table 4.

Table 4 Chemical characteristics of HID waste water

Chemical Characteristics	**Drain No.**				**Tolerance limit (max.) NS 229-2048**
	1	2	3	4	
1. pH	6.0	>11.0	9.0	6.0	5.5-9.0
2. COD mg/l	76	1390	1520	114	250
3. Oil & grease mg/l	NA	NA	56	NA	4.0
4. Lead mg/l	<0.01	<0.01	<0.01	<0.01	0.1
5. Chromium mg/l	<0.01	0.02	0.85	<0.01	0.1
6. Cadmium mg/l	<0.01	<0.01	<0.01	<0.01	2.0
7. Copper mg/l	<0.01	0.06	1.56	<0.01	3.0
8. Nickel mg/l	<0.01	<0.01	<0.02	<0.01	3.0
9. Zinc mg/l	0.04	0.3	0.09	0.04	5.0

COWI, 1996

The samples analysed were from different drains. The pH exceeded the acceptable limit in drain 2 and COD exceeded the acceptable limit in drains 2 and 3. Oil and grease were present in drain 3. Although only a sample from drain 3 exceeded the chromium limit, heavy metals were present in all samples. When effluent samples from individual industries were measured for metals such as lead, nickel and zinc, levels exceeded tolerance limits. The bio-accumulation of heavy metals is significant in light of the fact, that waste water is used for agriculture and vegetable washing in the Karra River.

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[13] COWI/Kruger Consult/ Nepal Consult, 1996; Pollution Prevention Demonstration Project, Hetauda Industrial District

The impact of the discharge of HID waste water on the quality of water in Karra River is shown in Table 5. It can be observed that dissolved oxygen (DO) decreases downstream with an increase in COD and chromium levels, both exceeding the acceptable limit. This shows that the Karra River is polluted by waste water from HID. HID produced 1,347 tons of solid waste in 1994/1995, of which 31 tons was hazardous waste Haphazard waste disposal pollutes surface and ground waters.

Table 5. Water quality of Karra River

Parameters	**Location of water sampling station**			**Tolera limit (m NS 229-**
	Water intake	Karra Bridge (300m from intake)	Downstream Karra River (300m from intake)	
pH	5	6	6	5.5-
DO mg/l	6.6 - 9.8	3.4	2.8	-
BOD5 mg/l	3	174	117	-
COD mg/l	38	243	304	250
TSS mg/l	19	152	58	30-
Chromium mg/l	0.04	0.06	0.47	0.1

COWI, 1996

6.5 Groundwater Quality in the Kathmandu Valley

The shallow unconfined aquifer is used widely by the Kathmandu Valley citizens for domestic water supply. Most of water samples (60%) from the shallow aquifer contained faecal indicator bacteria and this was generally associated with elevated concentrations of ammonia[14]. Heavy metal concentrations are generally low. Dug wells are more contaminated than shallow wells and deep wells are least affected. Four out of 20 deep tube wells sampled among the Nepal Water Supply Corporation production wells, contained faecal indicator bacteria, which is likely to be contaminated near the surface rather than in the aquifer. Pollution of the shallow aquifers beneath the cities of Patan, Kathmandu and Bhaktapur is serious, where leaking sewage pipes and septic tanks are widespread. Pollutant concentrations are greater during, and immediately following the monsoon period. Pollution of shallow aquifers is a serious health hazard for the people of Kathmandu. (Jha et al, 1997)

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[14] Mani Gopal Jha, M. S. Khadka, et al., 1997; The assessment of Groundwater Pollution in the Kathmandu Valley, Nepal - Report on Joint Nepal-Australia Project, 1995-96

6.6 *Sedimentation in River Basins*

Nepal has high drainage density of rivers. The influence of heavy rain during the monsoon period causes substantial variations in river flow, erosion and land slides. Coupled with the fragile geological composition of the country, this produces high sediment loads in rivers. During summer, snow and glacier melt also gives rise to heavy sediment loads.

On the basis of available data, often discontinuous and location specific, the average specific yield of suspended sediment has been estimated to be approximately 3 690 tons/Km^2/yr. Considering 15 per cent of suspended sediment as bed load, the total specific sediment yield of the country has been estimated to be approximately 4 240 tons/Km^2/yr. This is certain to have an adverse impact on water quality.

The impact of excessive siltation and/or high turbidity of river water on irrigation, water supply, and hydropower schemes has not been quantified but are easily observed. Sedimentation in water bodies alters the regime of conveyances as well as the finer fractions acting as carriers of the adsorbed chemicals such as phosphorous, chlorinated pesticides. High turbidity and concentrations of metals disrupt the aquatic system.

6.7 *Environmental Impacts of Water Development Projects in Nepal*

Although Environmental Impact Assessment is fairly a new concept in Nepal, it has been made mandatory for medium and larger sized water development projects. This concept has been well introduced in the feasibility studies of projects such as Arun III Hydro-Power (402 MW), the Karnali Chisapani Multipurpose (10 800 MW), Kali Gandaki A Hydro-Power (144 MW), Kodkhu Water Supply and the Greater Kathmandu Water Supply (Melamchi Project Supplying Water to the Kathmandu Valley from outside the valley source) and scores of others.

The *Environmental Protection Act 1996*, has been promulgated and the *National Environmental Impact Assessment Guidelines* which were formulated by the National Planning Commission (NPC) with assistance from the International Union for the Conservation of Nature and Natural Resources (IUCN) was gazetted in 1993. The Ministry of Water Resources (MOWR) has also published a manual on *Environment Protection Measures for Hill Irrigation Schemes in Nepal, 1992*. Sectoral Guidelines on EIA have already been prepared.

Other positive developments in the environmental area have been the formation of the Environmental Protection Council (EPC) under the chairmanship of the Prime Minister in October 1992. The EPC is an apex body to develop, execute, monitor and coordinate the activities of ministries and agencies related to the environment.

In Nepal, the environmental impacts of water development projects are soil erosion, land slides, loss of vegetation, water use conflicts, changes in demographic patterns, inundation or damage of historical/cultural monuments, glacier lake outburst floods (GLOF) etc.

7. Institutional And Legal Framework For River Water Quality, Protection And Management

The government of Nepal has always attached high priority to development of water resources. The institutional set up is being progressively updated and strengthened with suitable legal framework.

7.1 Institutional Framework

The primary organisation responsible for the development and management of water resources of the country is the Ministry of Water Resources. The government makes decisions regarding the responsibility and authority of institutions in the water resources development sector. The utilisation of water resources, safeguarding its quality and the various factors affecting it often transcend the sectoral areas addressed by any particular organisation. The other organisations involved are the National Water Resources Development Council (NWRDC), National Planning Commission (NPC), Nepal Electricity Authority, Water Energy Commission Secretariat (WECS), Department of Hydrology and Meteorology (DHM), Department of Irrigation (DOI), Ministry of Housing and Physical Planning (MHPP), Department of Water Supply and Sewerage (DWSS), Ministry of Local Development, Ministry of Industry, Ministry of Forests and Soil Conservation, and Department of Soil Conservation and Watershed Management (DSCWM) are the central level organisations with offices in various regional and district levels. They are responsible for different aspects of establishing and enforcing policies and regulations, water use and conservation, soil conservation, watershed management and so on.

The Nepal Environmental Policy and Action Plan (NEPAP) issued by His Majesty's Government's (HMG) Environmental Protection Council in August 1993 states the following among the aims of the government's environmental policy:

- To manage efficiently and sustainably natural and physical resources
- To mitigate adverse environmental impacts of development projects and human actions
- To integrate environment and development through appropriate institutions, adequate legislation and economic incentives, and sufficient public resources.

Though the above-mentioned broad based objectives and mandates are in force there is a shortage of adequate water quality standards, pollution effluent control mechanisms or monitoring activities at present. There are no effective regulations on the quality of industrial effluent or methods for disposal.

With the absence of regulatory mechanisms such as water quality standards, the work of agencies responsible for the protection and management of water bodies has become vague and futile in terms of quality preservation of fresh water. Though the spirit of legal provisions aims for conservation, meaningful enforcement is absent. This is a growing concern for government agencies.

Widespread erosion and sedimentation are immediate concerns, particularly in light of the viability of various irrigation, reservoir/storage and hydropower projects. The government has to incur huge costs due to natural and human-induced erosion. The government has introduced watershed area management and soil conservation efforts through the Ministry of Forests and Soil Conservation. The Department of Soil Conservation is the agency under the Ministry that has made efforts in watershed area protection, albeit small. Environmental effect monitoring (EEM) is also lacking.

Some groundwater quality monitoring do exist in the country. The Department of Hydrology and Meteorology monitors the suspended loads in selective areas and the water quality of Kathmandu Valley and Pokhara Valley. The Department is planning to extend this activity to other areas of the country. The Department of Water Supply and Sewerage also conducts water quality tests on possible sources of drinking water.

The Groundwater Resources Development Board (GWRDB) also conducts studies on the chemical composition of groundwater at the time of well construction. However, regular monitoring of groundwater quality based on a scientifically designed monitoring network of tube wells does not exist in the country. Groundwater quality monitoring for environmental impact assessment of East Rapti Irrigation Project has been in place since 1995. This program will also monitor pesticide contamination of surface and ground waters.

There are some ongoing studies regarding industrial effluents and impacts on receiving waters being carried out on an ad hoc basis with some foreign assistance and consultants and non-governmental organisations such as Japan International Cooperation Agency (JICA), United States Agency for International Development (USAID), Nippon Koei, International Union for Conservation of Nature (IUCN), etc. These have certainly raised the awareness of the local community and groups are already forming to lobby for the conservation of rivers. This is especially true in the case of Kathmandu (regarding Bagmati and Bishnumati which have turned into garbage dumps) and Pokhara (regarding civic opposition to sewer outfall into the lakes).

The Water Resources Strategy Formulation undertaken by the government has identified the absence of efficient regulatory provisions for protection of quality of water bodies as a grave issue requiring immediate consideration.

7.2 Legal Framework

The *Constitution of the Kingdom of Nepal (1990)*, in its directive principle, directs the State to "use the nation's natural resources for the welfare of the nation" and adds that the State shall "increase awareness about the clean environment among the people and protect the environment from the negative impacts of the physical activities, and provide special protection to the rare wild animals, flora and fauna of the country".

The primary legal tool for the development and management of water resources is the *Water Resources Act, 2049 BS (1992)*. It gives absolute recognition to the State's ownership and control of water resources, empowers to regulate the utilisation, development and management of the nation's water resources whether surface water or ground water. This Act stipulates that while utilising water resources, works must be undertaken in such a manner that no substantial adverse effect occur by way of soil erosion, flood, landslide or by other nature.

The *Electricity Act, 1992*, stipulates that the electricity generation, extension or distribution shall be carried out without causing any considerable adverse impacts on the environment through soil erosion, floods, land slides or air pollution, etc.

The *Soil and Watershed Conservation Act, 2039 BS (1982)* has laid down provisions for the proper protection and utilisation of land, natural resources and watersheds. The *Nepal Water Supply Corporation Act 1989* has empowered the Nepal Water Supply Corporation to take necessary steps to control water pollution. Similarly, there is a legal provision to penalize anyone found contaminating drinking water .

The *Industrial Resources Act 1992*, has provision for a licensing system for the establishment and operation of cigarette, leather, beer, sugar, paper, textile, cement, carpet washing, soap, stone crushing and forestry based medium and large scale industries as they affect public health and the environment.

The *Pashupati Area Development Trust Act 1987*, aims to save the Bagmati River against pollution.

The Ministry of Population and Environment has the responsibility of environmental conservation, pollution control, environmental standards enforcement and monitoring and environmental impact assessment. This ministry links water resources to water uses.

The *Environment Protection Act, 2053 BS (1996)* states in its Preamble "Considering, that sustainable development is based on the inter-dependent relationship between economic development and environmental protection; and that a clean and healthy environment be maintained by minimising as far as possible the adverse impacts on humans, animals, plants, nature and physical entities due to environmental degradation and desiring that a legal instrument be promulgated regarding the protection of the environment through the proper use and management of natural resources....".

8. Rehabilitation of Water Quality of Rivers in Nepal

The problem of pollution and the degradation of water bodies has been taken seriously by Nepal. Though, at large, the pollution extent through out the country is not serious at present, and the river waters flow relatively pure; the possibility of future contamination can not be ruled out if preventive measures are not taken. Introduction of suitable standards, generation of mass awareness and water quality management programmes are in the offing.

In Nepal, recycling or reuse of water for the purpose of water quality protection is not currently in practice. Similarly, regulations concerning waste water disposal and their enforcement are also not very effective for many reasons. In the Kathmandu Valley there are only two sewage treatment plants (lagoons), one for Kathmandu and another for Lalitpur city. These two lagoons are not adequate to treat all sewage of Kathmandu and Lalitpur, hence untreated sewage is directly discharged into Bagmati, Bishnumati and Tukucha Rivers, turning them virtually into sewers.

8.1 Rehabilitation of Rivers in Nepal

The following measures are being planned to rehabilitate the water quality of rivers in Nepal. The section also includes the recommendations in the areas concerned.

8.1.1 Reduction of waste water through water demand management

Water conservation measures comprise prevention of losses, promotion of efficient use, recycling and reuse of water and establishment of appropriate water rates to reflect the scarcity value of water. Further saving is also envisaged through the application of modern technologies in irrigation such as drip and sprinkler irrigation and by careful planning of conjunctive use of groundwater with surface water. In water short basins, industrial and domestic sectors are being encouraged to recycle and reuse water on a large scale.

Water intake by industries is affected by the extent to which water is reused. Reuse is important for large scale industries using substantial quantities of water. Pollution of water as a result of effluent discharged is a serious hazard and is worsening. Although fresh water is a renewable resource, the generation of new and complex wastes by industries is adding to the complexity of water pollution. Both surface water and groundwater are affected by such pollution.

8.1.2 Economic instruments to promote water conservation and reduce water pollution

The introduction of economic instruments has been suggested by the government. This would include water pricing to promote water demand management so as to help ensure efficient use of water, recover water supply costs and protect the environment by reducing the quantity of waste water.

Since irrigation water use is about 80 per cent of the total water use, a reduction of water use in this sector through improvement of the water conveyance and distribution facilities as well as improvement of irrigation efficiency is expected to lead to the augmentation of water supply for domestic use. One of the effective ways to reduce irrigation water use is to discourage wasteful use through the introduction of appropriate water charges. A reduction in agricultural water consumption would also mean a reduction in pollution resulting from irrigation returns.

8.1.3 Application of clean technology

Economic development of any nation depends upon several factors such as energy production and conservation, raw materials like water, minerals, forest produce and capability and skill to manage the resources optimally. Adoption of cleaner modes of production helps in resource conservation and minimisation of gaseous, liquid or solid wastes.

Clean technology therefore requires waste prevention and reduction by reduced consumption of raw materials, modification and upgrading of the technological processes so that optimal utilisation of natural resources is made possible, and adoption of preventive rather than corrective approaches to pollution control. The government has already put in to force the legal provisions for environmental impact assessments and associated guidelines, which are expected to promote the use of clean technology and restrict pollution. These provisions may be going through the preliminary birth-pains, but shall be eventuality streamlined for suitability and effectiveness. Long term policies on agro-chemicals use is seen to be lacking at the present.

8.1.4 Prevention of soil erosion and sedimentation

Watershed management practices to reduce erosion and sedimentation problems are now underway in some regions. In Nepal, watershed management programs have been undertaken in all the eco-belts but have mainly been concentrated in the midlands. The nature of activities include:

- Conserve forest resources
- Reforestation of degraded forest land
- Discourage conversion of forest land into agricultural land
- Discourage traditional agriculture practice in sloping or unleveled surfaces
- Promote cash generating, suitable horticulture in the sloping land units
- Introduce Engineering measures (construction of check dams, bio-engineering slope stabilization works etc.) in high risk areas
- Construction of check dams in the gully erosion prone areas to conserve soil erosion
- Construction of check dams across the high sediment transporting stream channels and dredging of deposited sediments every dry season.

Currently, the Bagmati Watershed Project is underway with the objective of bringing about changes in land use and management within the catchment area of the Bagmati River so that the productivity of the land can be sustained and erosion reduced. Similarly, Phewa, Begnas Lakes (in Pokhara) watershed management projects are under way to reduce the sedimentation problems of these lakes which are very important for tourism.

There is a need for scientific and technical evaluation of soil conservation programs which should be carried out by project authorities in consultation with agricultural universities and other academic institutes. There is also a need to carry out in depth studies on sedimentation processes, sedimentation transport and deposition mechanics, sedimentation sources and yields and to review the actual reservoir sedimentation situation and formulate recommendations for future sedimentation policies.

Comprehensive watershed management programs normally provide multiple benefits. Therefore, it is recommended that soil conservation programs should be interwoven with comprehensive watershed management. Many soil conservation measures such as trenching, contour bounding, planting vetiver grass are proving extremely beneficial and cost effective.

8.1.5 Regulation and enforcement of waste water discharge

Control of waste water is both a municipal and industrial problem. In towns and cities that are undergoing rapid industrialization, municipal treatment issue are complicated by the addition of untreated or semi-treated industrial discharges into the municipal sewage collection systems. The government and the municipalities have always been awarding priority to this problem and several actions have been undertaken. The activities are affected by the lack of proper financial resources and to a lesser extent by mis-management and lack of understanding between the various parties concerned. The rapid growth in urban population and the increasing percentage of total available water that is utilised by industrial economies renders waste water discharge the first priority for water quality management in Nepal.

8.1.6 Monitoring and enforcement of waste water quality

In Nepal there are several Acts, previously mentioned, to prevent waste water disposal into water bodies and pollution of waterways. The implementation aspects of these acts and regulations as well as the standards are to be strengthened. The monitoring activities are being increased by the government as well as lobbied by the non-governmental and social organisations.

The case of the Bagmati river system is being addressed as the most acute one having additional religious implications. It has received the top most priority in water quality improvement programmes.

8.2 Rehabilitation of the Bagmati River System

In view of the present water quality status of the Bagmati River, the watershed conditions and the envisaged future environmental impacts the following measures have been suggested for immediate implementation.

- Set effluent standards
- Set ambient river quality standards
- Construct sewage treatment plants in Kathmandu Valley
- Treatment and industrial effluents by the industries,
- Establishment of an effective solid waste management mechanism

- Launch on-site sanitation programmes throughout the watershed,
- Ban river bed sand mining in the Upper Bagmati Basin where necessary
- Construct weirs in the Upper and Lower Middle Bagmati Basins

The responsibility matrix of these measures are shown in Table 6 below.

Table 6. Responsibility Matrix for Mitigation Measures

Mitigation programme	Lead responsible agency	Other agencies to involved
Setting of effluent standards	MOPE	MOWR, MOI, MHPP, MLD
Construction of sewage treatment plants in Kathmandu Valley	MHPP, MOPE	MLD, Municipality, DDC, VDC
Treatment of industrial effluents and standards	MOI, MOPE, FNCCI	Municipality, DDC, VDC
Establishment of effective solid waste management	MLD, MOPE, Municipality, DDC, VDC	NGOs, CBOs, Community
On-site sanitation	MHPP, MLD, DDC, VDC	NGOs, CBOs, Community
Ban on river bed sand mining in the Upper Bagmati basin	MLD, MOPE	DDC, VDC, NGOs, CBOs
Construction of weir	MOWR, MOPE	
Surface water augmentation	MOWR, MHPP	

Source NESS (1997)

The Melamchi Drinking Water Supply Project aiming to supply drinking water to the Kathmandu Valley from an external basin is also proposed to augment the Bagmati river flow with a 3 - 12 cumecs supply of fresh water. This is expected to improve the river water quality.

With an aim to improve the environmental conditions and the Bagmati water quality in the vicinity of Pashupatinath temple, His Majesty's Government has initiated a programme to construct a sewer line from Gokarna gorge to Tilganga including a sewage treatment plant to treat the waste water before discharging it into the river. A High Powered Committee, a separate institution, has been constituted for implementation and monitoring of the Bagmati Area Sewerage Construction/ Rehabilitation Project. It is reported that after the completion of this project, the committee will extend its activities to the downstream sections of the river as well as other rivers in the Valley.

The overall activities that are being considered in the water quality management and related fields are described below.

9. Recommendations

9.1 Basic Strategy for Water Quality Management:

The problem of water quality and its remedy has to be approached from a wholistic point of view because both the causes and the effects of it's pollution are universal. It is imperative that the water quality component be synergically integrated in to the overall gamut of water resources management. This has also been recommended by Earthwatch, Global Environment Monitoring System, WHO/UNEP. Report on Water Quality[15]. the Integration of water quality elements into water resource management requires that the following three goals be pursued concurrently:

i. *Maintenance of Environmental Integrity*

Good water quality and suitability for all uses can only be maintained on a long-term basis if the aquatic environment is understood as a single ecosystem. Water quality then becomes the key element, not only affecting ecosystem health but also human water use and health. water dependent agricultural systems and industrial developments. Sufficient water of required quality can be made available for current and future use if the aquatic ecosystem is effectively protected from direct and indirect pollution.

ii *Public Health Concern*

The role of adequate quantity as well as quality of water for the preservation of the public health can never be under estimated. Maintenance of human health by prevention of disease can not be achieved without an adequate supply of water for drinking and other domestic purposes. This implies the provision not only of sufficient quantities of water but also of water which is free from pathogens and harmful chemicals. Therefore, either water resources must be protected from disease agents or adequate treatment must be provided where sufficient protection cannot be guaranteed. Diseases are not only caused by insufficient availability of good-quality water, but also by disease vectors breeding in surface waters. Aquatic ecosystems, particularly those involved in agricultural production, must be managed so that vectors are controlled without introducing new chemical contamination problems.

iii ***Sustainable Water Use***

Most efforts in development in Nepal have not yielded the desired outputs because of the sustainibility aspect, i.e., the aspect of the society being able to accept, bear and uphold the changes being made in the altered surrounding. Most socio-economic sectors cannot be developed and nurtured without adequate provision of water in sufficient quantity and of specific quality. Fisheries, agricultural crop production and livestock rearing, manufacturing industry, fossil and hydro-power plants, tourism and recreational activities- all in addition to ever-growing municipal demands - are dependent to a varying degree upon certain water quality criteria. Deterioration in water quality, resulting from over-use of resources, must be prevented in the early stages, necessitating policy decisions on competing sectoral water uses. A rational balance between water quality and quantity, taking account of possible treatment and re-use of waters and the future requirements, must be developed. Relevant policy-making should become an integrated element of rational water resource management along with the participation of the stakeholders.

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[15] WHO/UNEP, Earthwatch, Global Environment Monitoring System, WHO/UNEP Report on Water Quality, Progress in the Implementation of the Mar del Plata Action Plan and a Strategy for the 1990s.

9.2 Approach to Water Quality Management

The approaches to water quality management needs to be developed in the changed context of scarcity and competing uses of water, its economic edge and complexity of pollutants. This is reflected both in the field of water policy and in the design and operation of technical installations for water quality control. The global extent of water quality issues, including long-range pollution from diffuse sources and environmental degradation in forest or desert areas, presents a challenge in devising viable policies for environmental management. Such policies require profound insight into the mechanisms of demographic, social and economic developments and particularly into their influences on water resources.

For the rational and sustainable management of this limited resource, the interdependence between water quality issues and the quantitative use of water can not be ignored. Users competing for limited resources have greatly varying water quality requirements. This makes it imperative to provide sound water management based upon policies which reflect environmental needs and public preferences. It is also now recognized that the drainage basin provides the most useful hydro-geographic unit in which to manage rivers with regard to hydrology as well as quality. Within the watershed, aquatic ecosystems can be most effectively maintained and protected when consideration is given to the diversity and interdependence of all components of the hydrological cycle. This must be coupled with regulatory control and land-use planning, siting of industry and control of pollution associated with socio-ecomomic development plans. Underground water resources constitute a vital life-support system Costly and often irreversible damage have been inflicted on ground water resources in all continents. Ground water contamination is a long-term, cumulative process, and is more serious than river pollution because it requires extensive time periods for rehabilitation. Ground water protection must be looked upon as a matter of urgency.

9.3 Recommendations for Water Quality Management

It is imperative that any water quality management programme be implemented to address the elements of a strategy discussed above, viz., maintenance of environmental integrity, public health concern and sustainibility. The following is immediately apparent from the research carried out for this study. The stress that needs to be awarded to capacity building is also discussed subsequently.

Non-point pollution from run-off of agricultural inputs such as pesticides, insecticides, fertilizers, etc. is polluting not only water bodies but also sub-soil water resources and would affect the health of human beings. A long-term policy for pesticides use, including the introduction of environmentally acceptable pesticides, particularly biopesticides and non-persistent biodegradable ones, and integrated pest management together with the phasing out of the proven harmful toxic and persistent ones, should be formulated in collaboration with concerned ministries and infrastructure involved for its effective implementation. A similar policy for fertilizer use should also be formulated.

Water pollution control from waste water discharges should be controlled by a combination of regulatory and economic measures. Regulatory measures include water quality standards and/or objectives, effluent standards, and product standards. This last category defines that amount of a polluting substance that can be included in a product that is sold to the public or used in industrial processing. An example is a limitation on phosphorus in detergent because of the strong linkage between phosphate and eutrophication of surface waters. Economic measures include pollution charges on waste water discharges, and user charges as a means of reducing demand for water and, therefore, reducing discharges to municipal waste water systems.

Other measures should include relocation of squatters residing on the banks of polluted rivers; evaluation and support of the country's sewerage plan; installation of at least a primary sewage treatment facility; establishment of sewerage and sewage treatment facilities in housing complexes; introduction of programs that promote waste minimisation practices and clean technologies; enforcement of laws and regulations on water quality protection; collection of floating garbage from rivers with community participation; increased efficiency of solid waste collection; and public education and information dissemination towards prevention of indiscriminate waste dumping.

The basic areas that need to stressed upon and improved to address the concerns raised above and thus recommended for implementation are listed below. The domains that need improvement range from the central policy making and decision levels to the field implementation units and the grass root levels. These, as indicated by the approaches to management, are:

- Monitoring and evaluation
- Water pollutant control methods
- Legal and institutional requirements
- Economic tools and fiscal measures

9.3.1 Monitoring and Evaluation

Any rational water quality management decision must be based upon scientifically sound information, information that is yielded by a reliable monitoring mechanism. Generating the necessary data-base is not an end in itself, but provides the basis for evaluation in assessing the water quality situation, describing the aquatic ecosystem, forecasting trends, estimating the impact of pollution sources and supervising the effectiveness of pollution control measures. A mechanism should be developed to address both the point sources and diffused sources of pollution. The concept of basin-wide planning has to be introduced with the establishment of basin-wide monitoring networks. A suitable action plan for improvement is recommended to include the following.

- Establishment of purpose-oriented water quality monitoring systems serving multiple objectives such as ecosystem assessment, water-use planning and environmental impact assessment, policy option development;
- standardization of sampling methods, analytical procedures, data processing and data reporting over entire river basins or extended aquifers; and
- improvement of the reliability of monitoring data through up-grading and maintenance of laboratory services, rigorous analytical quality control, inter-laboratory comparison studies and designation or establishment of reference laboratories.

9.3.2 Water Pollution Control

The first and the easiest way to start controlling pollution is through the control of point source pollution. Considerable technological advances have been made in the developed countries regarding this matter and the transfer of technology to the lesser developed countries is the key solution to the complex problems. Relatively simple pollution control mechanisms also exist, for simple traditional problems, and these can be implemented with ease.

The challenge, however, is in the control of pollution from diffuse sources or non-point pollution which reaches the aquatic environment through urban or agricultural run-off, leaching into ground waters or atmospheric deposition. The nature of pollutants has also changed from biodegradable organic wastes to highly sophisticated synthetic organic chemicals with long-term persistence in the environment. New methods must be devised and implemented to control complex pollution problems and to cope with new and dangerous contaminants. The following is recommended in this area:

- Development of a coordinated intersectoral policies, regulatory statuatories and technical measures to prevent and control pollution of the vital water resources from point and non-point sources and to avoid its over-exploitation;
- use of suitable technical pollution control measures, such as low-waste industrial techniques, recycling of wastes or by-product recovery;
- introduction of methodologies to identify pollution levels through rapid assessment procedures, effluent monitoring, investigation of industrial processes and verification of the use of agrochemicals;
- Strict vigilance over potentially toxic chemicals throughout their "life cycle" from manufacturing to final disposal (or application for pesticides) so that its effects can be monitored and traced with subsequent control to minimize impact on aquatic systems and to prevent harmful health effects on water users;
- design and application of simplified and readily applicable methods to assess the environmental impacts of proposed major development projects in the watershed and the possible impairment of intended water uses; and
- introduction of regulation to promote the rational use of agrochemicals, the designation of ground-water protection zones and environment-oriented master plans for land use and basin-wide development.

9.3.3 Legal and Institutional Requirements

Every suitable activities mentioned above and the encouraging prospects in the field of water quality should be supported by an approved and accepted institutional and legal framework. For this a strong political and organizational framework facilitating the implementation of pollution control measures and enforcing it to the true spirit is desired. This involves the setting up of or empowering any of the existing government bodies for the necessary water quality management activities from planning to monitoring and to take stern actions against the defaulters. This should also be coupled with grass root awareness and mobilisation of the non-governmental organisation towards suitable goals.

Although management at the drainage basin level would be the best institutional structure, this is not always feasible because legal and administrative arrangements are generally made at the national level and water bodies frequently lie across national boundaries. Water quality issues such as transboundary pollution and long-range atmospheric transport of pollutants demand inter-country arrangements which range from notification to jointly established basin commission and operational authorities. Whatever type of organization is set up, its effectiveness is often determined by its practical independence in enforcing environmental protection and pollution control plans and issuing regulation for their implementation. Apart from the above, the following is recommended as necessary to achieve water quality management objectives:

- Promulgation and enactment of water-specific or comprehensive environmental laws which cover all aspects of water quality protection and pollution source control, and which enable the implementing organizations to issue regulations and standards and to enforce these;
- introducing suitable mechanisms for control of ground water usage and prevention of it being contaminated;
- improving the functioning of the existing organisations and reducing the enforcement gap with clearly defined terms of operation and authority. Relevant legislation have been adopted in some cases but the necessary resources or will to apply strict pollution control measures may be lacking;
- establishing a coordinated mechanisms for water resources management from the fragmented, multidisciplinary and inter-sectoral approach with clear-cut defined responsibilities and modalities amongst different agencies;
- performance of water quality monitoring and assessment by one organization to generate a coherent data base and to use limited analytical and skilled staff resources efficiently;
- encouragement of public involvement through regular public awareness campaigns, consumer information, co-operation with civic movements for environmental protection and resource conservation and the introduction of environmental issues in educational curricula at all levels; and
- adoption of compatible policies and regulations for pollution control and prevention throughout transboundary watersheds.

9.3.4 Economic tools and Fiscal Measures

The concept of water as a freely available public good has been overtaken by the concept of an economic good possessing high value. It is a commodity that is getting scarcer everyday and thus more valuable. It is a unitary resource that has competing uses and thus must address the avoided costs. Fiscal policies which promote pollution control and help internalize related costs are to be made important elements of any water policy. The concept of PPP - the polluter pays principle - has to be adopted (the individual user or polluter pays for quality used and quality changes caused by them-pollution costs would be paid either by a fee for treatment or by installing and operating individual treatment technology). The economic justification for pollution control has in the past been based on a calculation of the external costs of pollution - the cost that a user has to incur to purify water polluted by someone else. Although these costs can be estimated by calculating expenses of water treatment, it is difficult to quantify health, social and environmental benefits from pollution control in monetary terms. It is even difficult to assess the costs due to diffuse pollution.

As a consequence, water quality management cannot be based solely upon the application of economic criteria. Economic tools, for example, fees for effluent discharge or tax incentives, fees for environmental investments, are nevertheless used successfully in many countries. The full potential for use of economic tools in protecting and improving the quality of water resources has not yet been explored and more innovative efforts need to be launched. Some general recommendations in this regard are:

- charging point sources of pollution directly for the quantity and environmental hazard of wastes discharged in accordance with the "Polluter Pays Principle";
- levying a surcharge on water supply and abstraction, including those from ground water, which covers costs of waste-water treatment and disposal from urban multi-point sources which are difficult to regulate individually. Similar surcharge could also be levied as product surcharge on hazardous chemicals sold to domestic, agricultural or industrial users. Revenue generated from this surcharge would be used exclusively for water treatment and ecological protection measures;
- introducing tax exemptions, providing bonuses and subsidizing environmentally-sound practices, including agriculture, and compensating for restrictions on crop or livestock farming. Such a policy would promote environment friendly technologies and reduce surface-and ground-water pollution from diffuse agricultural sources;
- increasing the price of water in areas of ground-water over-exploitation for the purpose of water conservation and prevention of salt-water intrusion and other contamination; and
- providing tax incentives and other economic benefits to industry with the aim of stimulating water conservation, recycling of water and minimizing waste discharges.

9.4 Recommendations for Capacity Building

Apart from the above there is a definite need for capacity building of the concerned institutions and the nation as a whole for addressing the complexity of water quality issues and adopting the range of necessary measures to safeguard water quality protection.

Measures to control pollution at source are hampered by technical, operational and maintenance problems and even more so by the acute lack of financial resources. Without massive and dedicated support from the scientific community and financial donor agencies of the more affluent countries, many of the most precious world freshwater resources will experience severe and, in some cases, irreversible damage in the coming years.

- Research and Development
- Development of Institutional Capabilities
- Human Resources Development

The development of human resources through education and training is a key to the long-term protection and rehabilitation of water quality in the rivers of Nepal. Human resources development in this field can take several forms:

- Education and training
- Exchange of technological know how and experience
- Strengthening of training institutions

Education and training: Education and training may be carried out both formally and informally. Formal education and training includes incorporation of the concepts of water and sustainable development in school and college curricula, establishment of formal undergraduate and post-graduate courses on the subject and formal training courses on the subject at different levels.

Informal education and training includes organisation of informal training courses, workshops and seminars on the subject; providing on-the-job training of nationals on the subject by either international or national experts or consultants; and conducting study tours to other more advanced countries to assimilate their knowledge and experience.

Exchange of technological know how and experience: The transfer of technology in the field of water and sustainable development calls for cooperation between Nepal and the international community.

Strengthening of training institutions: For protection and rehabilitation of water quality in rivers, Nepal must have both the manpower and know how in this field, and it must have the capabilities in terms of adequate local technicians to undertake necessary measures. A necessary condition for this is to have appropriate training institutions. In this regard, Nepal should promote and facilitate the organisation of education and training in the field of technology concerning rehabilitation of contaminated rivers.

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Final Project Report

Issues in trade, environment and sustainable development: policy implications for India

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ISSUES IN TRADE, ENVIRONMENT AND SUSTAINABLE DEVELOPMENT: POLICY IMPLICATIONS FOR INDIA.

PEERS PROJECT BY DAMANDEEP SINGH AHLUWALIA.

INTRODUCTION

In recent years the intricate relationship between environment, economics, and international trade has illustrated the need for their integration as a means to achieving sustainable development. Environmental policies have largely been viewed as appendages, in which remedial action is taken once other economic priorities have been met. However, with recent global environmental concerns coming to the fore at the Earth Summit in Rio de Janeiro it is increasingly being recognised that sustainable development requires the integration of trade, environment and development concerns at the outset of the decision-making process, so as to align core macroeconomic strategies which include trade and environmental goals. Consensus is slowly emerging on the need to recast conventional economic wisdom at the national and international levels in order to incorporate elements of sustainable development.

While a majority of the countries redraw their trade policies after the formation of the World Trade Organisation (WTO) to usher in an era of open and expansive trade, there are concerns about a collision between freer trade and policies being utilised to protect the environment. Many developing countries have raised concerns that the promises now being made to integrate trade and environment policies will be illusory and undermine the achievements of the Uruguay Round their recent shift to liberalise their economies. They fear increased input costs and drop in their market access.

Many economists contend that if all the current external environmental costs were internalised and sound environmental policies instituted to enforce this process, then trade and environmental policies would not conflict with each other. This however, is long way off at the moment. Full cost internalisation is rarely possible and sound environmental policies have yet to be universally implemented. Consequently, we live in a world where some countries are further down the road than others, with international trade and investment tending to exaggerate these differences.

Increasingly, "green consumers" in the developed countries asking for environmentally-benign products for the exporting nations. Some among them are also of the view that the swelling international trade leads to environmental degradation. Developing countries including India, have voiced concern that with the World Trade Organisation coming into existence, there is fear that non-tariff barriers, in the form of environmental and health criteria, might be erected to keep exports out of developed countries.

As most of India's exports like chemicals, minerals, textiles, leather, tea, coffee, fish and shell fish are "environmentally sensitive" this requires urgent attention. Of particular importance are the changing preferences in Germany, the second largest importer of India goods with a turnover of nearly $ 10 billion. This has gained added importance with recent controversies surrounding German rejection of India tea because of high pesticide residue as well as the German ban on import of textiles coloured with azo dyes. The government including the ministry of environment and forests have decided to do the ostrich trick and hope that the problem goes away. Instead of researching changing trends of western consumers, the government had earlier tried to gloss over the issue. At the local level the government has been content with holding seminars on the issue, while at the international level all it has done is to ask for extensions on bans of certain items like in the case of azo dyes. Indian exporters, considered to be quick on the uptake have also been caught on the wrong foot. Thus there is need for governments and non-governmental groups in the developing countries to understand the issues better and respond to them.

SCOPE

The United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro, Brazil, in June 1992, recognised that developing countries, such as India, need improved market access, access to and transfer of technology and new and additional finance to assist them in achieving sustainable development and to contribute to tackling global environmental problems, in accordance with the principle of common but differentiated responsibilities.

In June 1997, the Special Session of the United Nations General Assembly (UNGASS), reviewed progress in the implementation of UNCED, particularly Agenda 21, which contains commitments for a blueprint for action into the 21st century. The results however have been disappointing, particularly with regard to finance and technology transfer.

This paper focuses on the institutional aspects of trade and environment issues and their application to India. Special attention will be paid to issues such as the effect of environmental measures on market access, the relationship of Trade-Related aspects of Intellectual Property Right (TRIPS) to the transfer of environmentally-sound technologies, and the relationship between TRIPS agreement and the Convention on Biological Diversity (CBD). In addition there are the new and emerging issues like voluntary standards, the issue of eco-labels and green consumerism.

At the global level, groups like the WTO have failed to evolve uniform rules that govern environmental conditions as applied to trade. In November 1996, the World Trade Organisation (WTO) Committee on Trade and the Environment (CTE) issued its first report, and to widespread disappointment, generated few recommendations. Environment-related disputes at the WTO continue to stir up controversy. The CTE has made little progress in reconciling trade and environmental goals. Future efforts by the CTE would benefit from a more focused mandate, increased environmental participation, and further analytical input.

India has contributed in a substantial measure to the debate at the international level raising crucial issues like relationship between TRIPS agreement transfer of environmentally sound technologies as well as the relationship between TRIPS agreement and CBD. However, at the national level, when there vital question of cost internalisation of industrial or allied activity, little progress has been made. This has not only caused internal conflicts between different users of the natural resources, but also made it vulnerable to actions by importing countries.

It is my argument that the country would do well to understand the global trends and move towards cost internalisation while keeping up the pressure in bodies like the CTE to get a better deal.

THE GLOBAL SITUATION

The Rio Bargain

Agenda 21 was heavily debated and negotiated at the United Nations Conference on Environment and Development (UNCED), also know as the Earth Summit. In order to understand the commitments made in the area of trade, it is necessary to put them in the context of the broader discussions. Trade, like other issues, was part of what has since been called the "Rio Bargain"[1].

Broadly, the priorities of the developed countries were chiefly environmental, while those of the developing countries focused primarily on development and economic growth. These objectives were reconciled by a "bargain" of sorts, in which the developing countries would support multilateral environmental agreements such as the Convention on Biological Diversity and the Framework Convention on Climate Change, and would adopt and enforce appropriate environmental legislation domestically. For their part, developed countries would facilitate this process through various means, such as capacity building, increased financial transfers, action on debt, technology transfer, and reduced trade protectionism, in recognition of the fact that increased exports can provide the resources for strengthened environmental protection. This was seen to be a deal under which all would benefit, as argued in A21, 33.3:

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[1] Rio+5 Special Focus Report. Trade and Sustainable Development Report. Prepared by International Institute for Sustainable Development. March 1997.

"... In light of the global benefits to be realised by the implementation of Agenda 21 as a whole, the provision to developing countries of effective means, inter alia, financial resources and technology, without which it will be difficult for them to fully implement their commitments, will serve the common interests of developed and developing countries and of humankind in general, including future generations."

The most direct elements of the Rio Bargain which concern international trade is the commitment by states to liberalise international trade, and specifically to complete negotiation of the Uruguay Round. This was seen as a way to ensure the possibility of economic growth for all countries, including developing countries which would benefit from a rules-based system. Progress on this commitment was positive; the Uruguay Round was completed in 1994, and resulted in the establishment of the World Trade Organisation (WTO). Whether achievement of this goal in fact produced the intended sustainable development results is a question which has been addressed in depth elsewhere.

Another element of the bargain was the opening of protected markets in developed countries. Like many commitments in Agenda 21, this one had a trade-off counterpart. In this case, it was that developing countries continue to implement neo-liberal structural adjustment policies such as those dictated by the World Bank and the International Monetary Fund (IMF). On paper, there is progress toward the first part of this bargain. In the Uruguay Round, there was liberalisation of trade in agriculture, and a phase out schedule was established for the Multi-Fibre Arrangement (textiles and clothing). These sectors, of interest to developing countries, had long been "out of the system", and subject to special exceptions which protected developed country producers. In fact, the phase-out schedules of the major potential textile and clothing importers have resulted in little opening as yet, and their loading of meaningful measures to the end of the ten-year period raises questions about whether adherence to the agreement at that time will in fact occur. In agriculture, while a WTO definition of subsidies is a positive step, actual reductions of subsidies are based on inflated base year periods, resulting in little if any difference as yet for developing country exporters.

On the other side of the bargain, it is difficult to assess the adherence of developing countries as a whole to continued neo-liberal reforms. Certainly many Latin American countries have, either unilaterally or under the terms of IMF or World Bank agreements, implemented such reforms since 1992, including an opening of markets to foreign investment and imports. A number of other countries in Africa and Asia have done the same. These structural adjustment reforms have a wide range of potential negative impacts on sustainable development, unless appropriate policies are implemented to ensure they do not.

Another element to which states were committed under Agenda 21 was reform of the workings of the world's commodity markets. The intent was to find

"...ways and means of achieving a better functioning and enhanced transparency of commodity markets, greater diversification of the commodity sector in developing economies within a macroeconomic framework that takes into consideration a country's economic structure, resource endowments and market opportunities, and better management of natural resources that takes into account the necessities of sustainable development."

This issue is particularly important for developing countries whose economic development is still heavily dependent on commodity production. Internal commodity prices have continued on their secular decline, forcing producers to intensify production while providing them with fewer resources to confront the environmental consequences of intensification. Attempts to increase rent capture through more processing are often defeated by escalating tariffs in importing countries – tariffs designed to protect domestic producers of primary commodities. Agenda 21 specifically mentions the need for improvements in the function of the agreements on cocoa, coffee, sugar and tropical timber (A21 2.16(a)), where producerconsumer agreements are suggested, and for the reduction of escalating tariffs on such goods. Few of the commitments in this area have been undertaken.

Progress on most of the issues linking trade and sustainability has been decidedly lopsided. On the commitments by developed countries to increase flows of official development assistance, facilitate technology transfer, take action on debt, and help build capacity in developing countries to foster sustainable development, performance has been abysmal, as described in various other focus reports. As noted above, progress has been noticeable if not uniform in the commitment by developing countries to continue with neo-liberal reforms. As well, most developing countries have in fact ratified the multilateral environmental agreements (MEAs) signed at Rio, as well as other MEAs to which there is commitment in the Agenda 21 text such as the Basel Convention and the Montreal Protocol.

Broadly, the post-UNCED debate has recognised that trade liberalisation should be accompanied by environmental and resource management policies if its full potential contribution to better protecting the environment and promoting sustainable development through more efficient allocation and use of resources is to be realised.

Much of the trade and environment debate has focused on the relationship between trade measures in MEAs and the provisions of the multilateral trading system. While views differ on whether any modifications to the provisions of the multilateral trading system are required, progress has nevertheless been achieved in building mutual understanding and respect between trade and environment communities. In addition, a number of recommendations may help prevent conflicts from arising, such as policy co-ordination at the national level and improved compliance and dispute settlement mechanisms available in MEAs. There has been increased recognition that positive measures are important and can be indispensable elements to assist developing countries to become Parties to an MEA and to tackle the environmental problems that the MEA is seeking to resolve, in keeping with the principle of common but differentiated responsibility.

The debate has shown that a number of outstanding and emerging issues still need to be addressed in order to further build a balanced and integrated approach to trade, environment and sustainable development agenda. The sustainable development agenda should focus on the promotion of trade investment, building on potential synergies between trade liberalisation, economic reform, and improved management of natural resources and the environment. This requires an examination of the role of investment, incentives, economic instruments, and other initiatives in broadening the options for the effective implementation of positive measures including access to and diffusion of environmentally sound technologies, involving the business community and the civil society in the design of such measures.

In the post-UNCED era progress in other priorities identified in Agenda 21, such as the provision of additional financial resources and access to and transfer of technology, has not as yet fulfilled the expectation of Agenda 21, trade liberalisation and improved market access have become even more necessary as a means of generating sources of financing for sustainable development.

In the discussion in the CTE many have considered that the focus of further work should be on trade and trade-related measures applied by WTO members that will remain after the Uruguay Round results are fully implemented.

In the post-UNCED process, progress has been made in better understanding relationship between trade liberalisation, environmental benefits and sustainable development. Many economists believe that, in the absence of significant market and policy failures, trade liberalisation can result in reduced negative environmental impacts. Firstly, by improving the efficiency of resource allocation and use, trade liberalisation will result in the use of fewer inputs (including of environmental resources) for the same level of output of goods and services. Secondly, by generating growth, trade liberalisation will help to increase demand for environmental quality and relieve environmental pressures associated with poverty. Opening new market opportunities for developing countries should reduce the dependence of such countries on resource-intensive activities. And improving living standards is likely to enhance both the ability and the willingness of countries to devote more resources to environmental protection.

The Commission for Sustainable Development (CSD) has noted that national governments have an interest in analysing environmental and social effects of significant changes in the volume and patterns of composition in production and consumption, including those resulting from trade policy reforms, and making, if required, the necessary policy adjustments with a view to correcting market and policy failures and internalising environmental costs. The Organisation for Economic Cooperation and Development (OECD), as part of its work on procedural guidelines, has developed a guideline on trade and environmental reviews. Environmental reviews may by used by Governments, at the national level. Further work is needed on conceptual and methodological aspects.

WTO TRACK RECORD

It is evident that making the transition to sustainable development will require substantial amounts of capital; UNCED has calculated that over $ 200 billion a year would be necessary. However, it is now clear that little of this money will come from parsimonious Northern parliaments. For many countries, much of the new capital will have to come from increased trade revenues which annually value about $ 5 trillion. In that sense, trade liberalisation may be said to be a necessary, although not sufficient, condition for the achievement of sustainable development. Greater access (and quicker access) to Northern markets than that provided under the Uruguay Round would provide substantial sums to Southern economies. United Nations Development Programme (UNDP) has estimated that each year developing countries lose $ 200 billion in potential export revenue because of barriers to trade in the North. But trade liberalisation without adequate environmental policies can be very damaging to the environment.

In the WTO the Committee on Trade and Environment (CTE) is the most crucial to the sustainability agenda. However, the working agenda which it has adopted is narrower than the task originally outlined: to address trade and sustainable development and to make recommendations on whether any modifications of the provisions of the multilateral trading system are required. Instead, the Committee has chosen to settle on a number of specific issues related to the trade impacts of environmental policies.

The CTE has addressed its essentially political task in a largely technical manner. Few of the issues on the agenda appear ready for action, so the most likely outcome of two years of work will be to recommend a renewed mandate for the Committee. The CTE has struggled with the conundrum that faces any environmental body: the issues it addresses are cross-cutting, affecting virtually every part of the WTO, and numerous organisations outside the WTO. Environmental issues occur explicitly or implicitly on the agenda of numerous other WTO bodies.[2]

It is worth noting that the first dispute under the new regime to reach the stage of a complete panel report concerned an environmental issue. Venezuela complained against the impact of aspects of the implementation of the Clean Air Act in the United States on Venezuelan refineries. The WTO Venezuela Panel addressed technical issues of environmental policy. Yet, there is no evidence that the use of experts was considered in this instance, by the panel or by any of the parties.

The panel report also entered territory which has long posed particular difficulties for GATT panels. The US argues that its regulation treated imported gasoline similarly to gasoline for "similarly situated" domestic parties. The panel rejected this view because "any interpretation of Article XX (g) in this manner would mean that the treatment of imported and domestic goods concerned could no longer be assured on the objective basis of their likeness as products".

The environmental agenda will become an instrument of change in the GATT/WTO system because it responds to different incentives. It has raised the problems of transparency and participation in the WTO, as it did within the UN system, the World Bank and in bilateral relations between countries, which are in fact issues which transcend the environmental agenda and stand at the centre of important changes in contemporary international society. It is unlikely that the WTO will long be able to resist the pressure exerted by these changes.

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[2] The World Trade Organisation and Sustainable Development: An Independent Assessment. A Report by the International Institute for Sustainable Development. 1996.

The International Institute for Sustainable Development (IISD) report notes that few governments have shown enthusiasm for the agenda of trade and environment. It is viewed as primarily a concern of the developed countries, yet it is difficult to identify any among these, with the possible exception of the Nordic countries, which have consistently urged forceful action within the WTO to address environmental concerns.

Many developing countries have sharply articulated their concern that environmental issues may be used to create new barriers to trade and thwart hard-won gains in market access. Experience with a number of prominent cases, shows that this may well be true - ranging from US measures to impose certain standards to protect dolphins on Mexican and other ships fishing for tuna in Mexican and international waters, to Austrian requirements to label tropical timber, to U.S. measures implementing clean air standards in a manner that disadvantaged Venezuelan and Brazilian refineries.

The successful conclusion of the Uruguay Round and the launching of the WTO have come to symbolise a new era in international relations. The trading system has finally begun to deal with a number of issues which were previously taboo, such as agricultural subsidies. Progress has been made on dealing with services and intellectual property rights and a new system for resolving disputes has been put in place. Most important of all, the temporary, Northern dominated GATT, has been replaced by a soon to be universal trade organisation which consolidates the results of Uruguay and previous rounds in the text and under one roof. But the accolades for the WTO may well be premature.

A period of unrivalled wealth in much of the world is being accompanied by rising levels of insecurity even in affluent societies and growing inequality between those who succeed and those who do not. Continuing support for liberalisation and globalisation depends vitally on the ability of government at all levels to ensure that the benefits are widely distributed, and that the legitimacy of the trade regime is widely accepted.

They must also persuade an increasingly sceptical public that liberalisation can contribute to environmental improvement. The WTO has failed to recognise the central message of sustainable development—that the world's economy and its environment are joined at the hip like Siamese twins. Progress in one area depends upon progress in the other. Trade liberalisation without adequate environmental safeguards will lead to environmental deterioration, often on a massive scale. And trade liberalisation and the increased revenues which it brings is an essential condition for the achievement of sustainable development.

Will the WTO be able to respond to these essentially political challenges? The first two years have not been encouraging. The dominant theme has been continuity from the GATT to the WTO. A culture of closed decision-making has persisted, inefficient internal structures have carried over without reflection, and the dispute settlement process still resembles the rules committee of a club. The Committee on Development has achieved nothing notable and the Committee on Trade and Environment may continue a record of futility which now dates back 24 years to the first creation of the abortive environment committee of the GATT. The Councils on Intellectual Property Rights and Trade in Services have spent most of their two years on mundane housekeeping tasks.

IISD has recommended that sustainability must be built into the mandates of the Councils and Committees of the WTO. The Committee on Trade and Environment could play a key role in defining the relationship between the trading system and the environment if it begins to treat the issue as a vital part of the integrity of the trading system and not just as an annoyance imposed from the outside.

The TRIPS regime is critical to the shift to new, more eco-efficient technologies. Trade in services, from the more narrowly defined environmental service industries, to consulting services, finance and banking, will be critical to the achievement of sustainable development. The reform of the notification procedures under the Technical Barriers to Trade (TBT) agreement will be important to help insure against protectionist capture of the environmental agenda. TBT is also at the centre of the discussion about ecolabelling.

The key to ensuring the support of many developing countries for the sustainability agenda in the WTO is a renewal of some elements of the Rio Bargain. This renewal will need to be built on guarantees of increased market access and further progress on the reduction of market distorting subsidies in the North. The Committee on Trade and Development could take on some of these responsibilities within the WTO structure if it is given a new mandate and renamed the Committee on Trade and Sustainable Development.

Further progress must also be made on reform of the dispute resolution mechanism. The US/Venezuela Panel Report demonstrated the same kinds of eco blindness displayed by panels under the old system. But the Appellate Panel decision gives some cause for hope that the system can become more even handed.

Recently, in a major victory for India and several co-complainants, the WTO ruled that a US embargo in banning imports of shrimps from India on environmental reasons was untenable. A WTO panel ruled that the U.S. ban on wild shrimp imports caught without the use of so-called turtle excluder devices (TEDs) violates international trade rules. TEDs allow sea turtles to escape from nets cast to harvest shrimp.

The US imposed a ban on shrimps' import from countries that do not require their fishermen to protect endangered sea turtles in May 1986. Interestingly, the environment ministry in a recent government meeting also stressed that TEDs were essential and said they had recommended its use as far back as 1994. Esimates by the Wildlife Institute of India, say that over 10,000 turtles are killed along Orissa's coast this winter. This ruling will now force the U.S. to lift the discriminatory measure, based on its Endangered Species Act, and which requires that all imported shrimp be certified as caught with this particular method of TEDs to protect sea turtles.

After the US instituted a ban in 1996, it was India, Pakistan, Thailand and Malaysia that brought the case to the WTO. The ban is largely viewed as an application by the United States of domestic environmental laws outside its borders. The U.S. maintains that the protection of the environment, and especially of endangered species such as the sea turtle, is a global concern.

The basis of the complaint was that the U.S. ban affects trade of the four countries by violating a number of articles in the General Agreement on Tariffs and Trade (GATT). Specifically, the complainants hold that the U.S. embargo violates GATT Article I, which establishes the most-favoured nation principle; Article IX, which prohibits quantitative restrictions or trade prohibitions other than duties and taxes; and Article XIII wherein restrictions on certain imports cannot be applied selectively to some WTO members and not to others.

The U.S. argues that its ban has sense as a necessary means to protect a global common and therefore falls into a category of measures exempted from those specific WTO disciplines and principles. While Thailand had the ban lifted by the U.S. in 1996 after ensuring that its fleet was equipped with TEDs, it has stayed in the case to defend the principle that one nation's values and laws should not be extended and applied to others.

It seems inevitable that further difficult environmental disputes will soon reach the panel process. Controversial panel reports are less likely if future panels take advantage of the new rules which allow them to hear expert environmental advice. Efforts should also be made to ensure that the panel reports are released as soon as possible and not restricted to everyone but the cognoscenti and readers of insiders' newsletters as they have been in the past. A somewhat bolder step, which would do more to reinforce the legitimacy of panel reports, would be to permit the filing of "amicus" briefs by concerned parties from civil society.

Whatever rules emerge in the coming years to address the complex relations between trade, environment and sustainability, it is important to ensure from the outset that they are not only equitable but also equitably implemented. Experience has shown that the most important steps towards the implementation of international agreements frequently occur long before these are signed or enter into force. Most of the necessary measures will be taken at the international level so that the need to ensure accountability for national measures is one of the most important functions of the WTO.

There is some evidence that the GATT adopted notification requirements as a no-cost alternative to more stringent international measures with little thought given to their effectiveness or to ensuring that they were forcefully implemented. The existence of more than 200 such requirements suggests that their implementation was never seriously considered. The result is a potential implementation gap as serious as in any other international regime. There is no evidence that these notification requirements have been effective in the trade regime. Notification systems between states do not function unless they are linked to strong incentives or are subject to public scrutiny.

The new WTO procedures for the circulation and de-restriction of WTO documents should, in theory, provide an opportunity for public scrutiny of the notification experience within the trade regime. Experience in other regimes, however, suggests that states dislike the exposure to public criticism, and even on occasion ridicule, which such scrutiny can bring with it and may therefore seek to curtail opportunities for it. The credibility of the WTO, and possibly the future of the trade regime, depend on the willingness of all concerned to tolerate such scrutiny.

TRADE-RELATED ASPECTS OF INTELLECTUAL PROPERTY RIGHTS (TRIPS)

This section explores the relationship between the provisions of the TRIPS Agreement, environmental protection and sustainable development, particularly in relation to the generation, access to and transfer of environmentally sound technologies (ESTs) and provisions of some MEAs.

Another commitment made in Agenda 21 was to recognise and foster the traditional methods and knowledge of indigenous people and their communities relevant to the conservation of biological diversity. States also pledged to, "ensure the opportunity for the participation of those groups in the economic and commercial benefits derived from the use of such traditional methods and knowledge" (A21, 15.4(g)). The WTO Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) touches indirectly on the same issues, in discussing what sort of intellectual property right protection countries should grant. Much of this knowledge relates to the nutritional, medicinal and pesticidal value of plant and animal species. According to the TRIPS agreement, plant varieties must be protected either by patents, or by a custom-made (sui generis) system at the national level. A sui generis system which granted rights to indigenous people and their communities might constitute fulfilment of the Agenda 21 commitments for sharing of benefits. None has yet been created. There is, moreover, some uncertainty about whether such a system would stand up to a WTO challenge; it would have to be found "effective"—a term as yet undefined by the WTO.[3]

The International Union For The Conservation Of Nature-Environmental Law Centre (IUCN-ELC) has focused on the relationship between TRIPS and the Convention on Biological Diversity (CBD) and stressed that the latter was more than a narrow environmental concern. The CBD covers: technology transfer; protection of intellectual property in relation to environmentally sound technologies and products, as well as informal innovations; and the sharing of benefits arising from the use of genetic rescues.[4]

However, at a WTO symposium[5] representatives of large, multinational corporations feel differently. Dupont representative argued that innovation lay at the heart of achieving sustainable development, that new technologies are needed to reduce waste and reduce the need for large environmental inputs, and that corporations are central actors in the transition to sustainable development. He cautioned that such expenditures on innovation are based on an assessment by each firm of risk and return. If firms cannot be guaranteed a return on investment, investment will not proceed. He said that TRIPS advanced sustainable development by protecting the return on innovation and providing incentives for investment. He warned that if industry were not allowed to take on the challenge of helping in the transition to sustainable development, the transition would not occur.

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[3] See Rio+5, op cit.

[4] Sustainable Development. Vol. 05 No. 01. May 1997. Report on WTO Symposium On Trade, Environment And Sustainable Development. A report prepared by International Institute for Sustainable Development. 1996.

[5] See Sustainable Development. Vol. 05 No 01. Op cit.

Others like The Tebtebba Foundation linked the TRIPS Agreement to a number of undesirable results, particularly in the context of the patenting of traditional knowledge. Such "monopolisation of public knowledge" has led to increased efforts by multinational firms to extract knowledge without due compensation, a practice she referred to as "biopiracy." She objected to language in the TRIPS Agreement that restricted the granting of patents to those innovations that were commercially applicable, noting that this left much traditional knowledge unprotected. She condemned the patenting of life forms, allowed under TRIPS, as an inappropriate intrusion of the WTO on the sovereign rights of nations. She recommended amending TRIPS with respect to environmentally sensitive technology and products (ESTP) to: allow for technology transfer of ESTP on concessional terms on the basis of need; relax patent protection for ESTP; strengthen provisions allowing States to grant compulsory licenses for ESTP; and shorten the periods granted for patent protection.

The US questioned the recommendations of the Tebtebba Foundation concerning reduced IPR protection for ESTP He argued that such actions would reduce incentives to produce ESTP by reducing the payback received by innovators, with the result that less innovation would transpire.

TRADE-RELATED ENVIRONMENTAL MEASURES (TREMS) AND GREEN PROTECTIONISM

This period has also seen the emergence of a new concept which is uncomfortable to many developing countries. Both Agenda 21 and the Rio Principles have in strong language been proscribing the inappropriate use of trade measures to achieve environmental goals, reflecting a developing country fear that TREMs will be used as protectionist devices to shut out their exports, frustrating economic growth. As above, many of the commitments undertaken in this context can be seen as bargains or trade-offs.

There is a strong commitment in Agenda 21 against the use of unilateral TREMs to address environmental concerns outside of a country's jurisdiction and a commitment to instead seek international consensus on issues of shared concern. As well, there is a commitment not to use TREMs to discriminate on the basis of process and production methods in the country of export. In return, states are committed to implementing appropriate environmental regulations and instruments, and to avoiding damage to the environment beyond their borders (Rio Principle 2). The essence of the bargain here is encapsulated in Rio Principle 11:

"States shall enact effective environmental legislation. Environmental standards, management objectives and priorities should reflect the environmental and developmental context to which they apply. Standards applied by some countries may be inappropriate and of unwarranted economic and social cost to other countries, in particular developing countries."

In the world envisioned by this bargain, all countries would enact environmental legislation which accurately reflected their own priorities, there would be no transborder environmental degradation, and no countries would try to discriminate against low-standard producers through the use of TREMs. Unilateralism—the taking of measures by a country alone, outside of the mechanisms offered by the system of multilateral rules embodied in the WTO—is shunned, since this is an option open to the most powerful, trading nations only.

Progress toward achieving this world has been decidedly uneven. Protection from the use of unilateral extra-jurisdictional TREMs has been achieved through the completion of the Uruguay Round and the strengthening of its dispute settlement mechanism. Under current interpretations of the GATT text, elaborated in dispute resolutions to date, such measures are not allowed. The same rules, however, makes it virtually impossible to use such measures to reinforce signatories' commitments to refrain from degrading the environment outside their jurisdictions. The commitment by states to implement domestic environmental regulations remains "soft law", in contrast to the increasingly rigid interpretation of the WTO when it comes to some TREMs.

That interpretation hinges on the concept of "like products" in the WTO legal texts. The notion of "like products" is central to the GATT/WTO system since its fundamental principles, most favoured nation treatment and national treatment both prohibit discrimination among "like products". The former bans unequal treatment at the border among exporting nations' like products; all WTO Members must be "most favoured". The latter bans unequal treatment within a country among domestic and foreign producers of like products. Several GATT and WTO dispute panels have interpreted the concept of like products in an increasingly narrow fashion, ruling that physically identical products are like, no matter whether they were produced in a way that benefited or degraded the environment. (This narrowing comes at a time when the like goods concept has actually been extended through the new Agreement on Trade Related Intellectual Property Rights, which legitimates important distinctions between otherwise like products based on respect for certain rights in the production process). The result is that countries cannot punish, at the border, goods which were produced in a way which degrades the environment.

Underlying the WTO interpretations and the Rio language against the use of unilateral extra-jurisdictional TREMs is the fear on the part of exporters, particularly in developing countries, that they will be used to erect protectionist barriers in the name of environmental protection. Agenda 21 and the Rio Principles come out strongly against such "green protectionism" There are good grounds for this fear, expressed as long ago as the 1972 Stockholm United Nations Conference on the Human Environment. "Green" Brazilian forest product companies, for example, argue that the EU's ecolabelling criteria for paper products is unfairly discriminatory, since it rewards recycled content—prevalent in Europe—more highly than the type of sustainable plantation management which they practice. Developing countries fear that as WTO disciplines scale back the tariff barriers to their exports, new barriers will take their place, including some which masquerade as environmental measures.

Implementing the Rio commitment to counter green protectionism would presumably start with efforts in the WTO and in international environmental regimes at all levels to distinguish it from "legitimate" environmental measures. Agenda 21 goes so far as to identify appropriate environmental standards at the international level, including consideration of the measures that may be required to implement them. Real progress would thus attempt to answer, at the multilateral level, what constitutes consensus, under what conditions it is required, and what types of measures might or might not be used in the various scenarios.

This important work has not taken place; the WTO's Committee on Trade and Environment (CTE) has touched only briefly on the subject in its discussions on MEAs, and on packaging and labelling regulations. In doing so, it has chosen not to collaborate with or consult outside bodies with environmental expertise.

Regarding the use of trade measures in multilateral environmental agreements (MEAs), states undertook in Rio to, "Develop more precision, where necessary, and clarify the relationship between GATT provisions and some of the multilateral measures adopted in the environment area." A small number of important MEAs contain trade measures as enforcement tools (the Convention on International Trade in Endangered Species of Flora and Fauna [CITES], the Basel Convention and the Montreal Protocol are examples), and there is some question whether these are in all cases consistent with WTO rules. While the CTE spent a great deal of time on this question in its first two years, it produced no recommendations. In its deliberations, the Committee struggled with the relationship with other bodies such as the secretariats of the MEAs in question. This was part of a larger problem of the WTO as it sought to define its position in international society. In practice, the CTE only established indirect communication with the secretariat of the Biodiversity Convention and the Commission on Sustainable Development.

NEW AND EMERGING ISSUES

Trading opportunities for environment-friendly products.

The CSD has noted that consumer preferences for "environment-friendly" products may create trading opportunities, including for developing countries. On the other hand, environmental claims may at times create informal obstacles to trade. Surveys of various categories of environmentally-preferable products have been conducted, but a better understanding is still needed. The potential role that the promotion of trading opportunities for environment-friendly products can make to sustainable development is worth probing. It requires further analysis of the size and stability of markets for environment-friendly products, possibilities to obtain price premiums, costs of producing, certifying, marketing these products, problems related to the definition and identification of environment-friendly products and certificate issues. In United Nations Conference on Trade and Development (UNCTAD), CTE and other fora some have noted that such opportunities are not easy to exploit and require expertise, technology, and resources which may not always be available to the developing countries.

Governments, international agencies, including the International Trade Centre (ITC), and the private sector could assist developing countries in entering niche markets for environmentally preferable products. Capacity building could be geared towards identifying markets for environment friendly products, raising awareness of these opportunities among producers, providing information to consumers, increasing the supply and improving the marketing of such products.

Conceptually and practically, there can be synergies between trade and environment-friendly products and internalisation of environmental costs by producers, to the extent that product differentiation may help in passing increased costs to consumers.

Eco-labelling, Life Cycle Analysis and ISO 14,000

Although attention in the past has been largely directed at the potential negative trade effects of product standards, from an environmental standpoint both product standards and standards related to PPMs need to be addressed. This because environmental problems are often associated with production process rather than the product itself. Moreover, these PPM related standards are becoming more stringent and comprehensive in the developed countries, in response to an improved understanding of environmental risk and public preference for tighter environmental protection.

However, experts feel that while the use of PPM-based standards for environmental purposes is essential, PPMs need not be a serious trade issue[6]. Since most environmental problems are intrinsically local and their effects not being transmitted through the product to the importing country, there is little justification for applying PPMs in imported products. Furthermore, international trade rules support the right of countries to their own environmental and developmental priorities.

Nonetheless, environmental management standards, such as the ISO 14,000 series are fast gaining ground. These comprise a range of standards including those relating to environmental management systems (EMS) and eco-labelling. UNCTAD recently held an expert meeting "to examine the operation, and the possible trade and investment impacts, of environment management standards, particularly the ISO 14,000 series on developing countries, and the identification of possible opportunities and needs in this context.

At UNCED, eco-labelling was considered in the context of changing consumption patterns, but not as a major trade issue. In the post-UNCED period, however, there have been intensive intergovernmental deliberations at UNCTAD, OECD, and the CTE and other fora on the relationship between eco-labelling and international trade.

This development can be explained by several factors. Firstly, since UNCED the coverage of eco-labelling programmes has been extended to include highly traded products. Secondly, eco-labelling has increasingly incorporated the life cycle analysis (LCA) leading to the use of criteria related to non-product related process and production methods (PPMs). Thirdly, specific cases, such a proposed eco-label for tropical timber in Austria and a European Union eco-label for paper, fuelled concerns about the trade effects of eco-labels. Finally, conceptually eco-label touches upon several aspects of the trade and environment interface such as the issue of non-product related PPMs and the legal definition of like products.

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[6] Vossenar, Rene and Veena Jha "Environmentally Based Process and Production Method Standards: Some Implication for Developing Countries". in Trade Environment and Sustainable Development edited by Veena Jha, Grant Hewison and Maree Underhill. MacMillan Press Ltd. 1997.

The CSD has recognised that eco-labelling can have an impact on trade. Several proposals have been put forward that aim at strengthening the compatibility between the environmental objectives of eco-labelling and trade interests. The International Organisation for Standardisation (ISO) has been developing international standards for eco-labelling, as part of the 14,000 series, to which eco-labelling bodies can adhere on a voluntary basis. These standards provide useful guiding principles for the operation of eco-labelling programmes, covering inter alia product environmental criteria, transparency, trade aspects, accessibility and mutual recognition.

Little progress has been made in building consensus on how to deal with the issue of non-product related PPMs. The relevant ISO standards, while recognising and, to some extent, encouraging the use of LCA, do not address the trade aspects of the use of PPM-related criteria in eco-labelling programmes. The only tool referred to in the corresponding ISO standards which can help to address such aspects is mutual recognition.

Mutual recognition, which in practice is a complex issue, requires that an eco-labelling programme is first established in the exporting country, something that has proven to be difficult in several developing countries. The concept of equivalency provides more flexibility in that it does not imply such requirement. Although several fora have recommended the exploration of the concept of equivalency, little progress has been made. Attempts to reflect this concept in the ISO guidelines has turned out to be a highly complex issue.

A recent study by the International Institute for Environment and Development (IIED) for the UN Department for Policy Coordination and Sustainable Development (DPCSD) provides a number of examples of Indian textile firms which have obtained environmental labels such as Century Textiles and Industries Ltd, Mumbai; Arvind Mills and Dura Tex Laboratories Pvt. Ltd. Century in now working towards obtaining the ISO 14,001 certification for its environmental management system.

THE INDIAN SCENARIO.

The government's response has been mixed. While it has rightly raised certain important matters related to the proliferation of environmentally sensitive technology and products (ESTP) as well as the relationship between the TRIPS agreement and the Convention on Biological Diversity at the WTO's Committee on Trade and Environment, action in the domestic front has been less than satisfactory.

In the CTE discussions India has stated that there appeared to be a real problem in reconciling WTO provisions on intellectual property protection, as laid down in the TRIPS agreement, with the objectives and provisions on transfer of technology incorporated in some multilateral environment agreements (MEAs). Based on the discussion on this issue, the CTE reported to the ministers that further work is required.[7]

The government pointed out that the TRIPS Agreement does not fully address the question of encouraging the global use of proprietary ESTPs. This gap needs to be filled at least in the limited context where proprietary ESTPs are mandated to be used by third countries under national or international law. Certain existing MEAs, and some future MEAs under negotiation, contain obligations to phase out certain substances or technologies which are prejudicial to the environment and replace them with specified substitute ESTPs within a certain time limit. Such MEAs may contain certain measures to help developing countries such as longer time limits, multilateral fund to finance such substitution, including for transfer of technologies and an obligation to transfer such technologies on "fair and most favourable" terms and conditions. Unfortunately, longer time limits are not strictly contingent upon obtaining the required financial assistance on technologies and developing countries are invariably faced with fast approaching deadlines with no hope of either adequate financial assistance to purchase the substitute technologies/products or of transfer of substitute technologies on "fair and most favourable" terms and conditions.

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[7] The Relationship of the TRIPS Agreement to the Development, Access and Transfer of Environmentally Sound Technologies and Products. November 1997. Ministry of Commerce. Government of India.

The government has also rightly pointed out the contradictions between provisions of the Convention of Biological Diversity (CBD) and the TRIPS agreement.[8] The first important contradiction is the lack of any condition on patent application (in Article 29 of the TRIPS Agreement) to mention the origin of biological and genetic resources and indigenous/traditional knowledge used in the biotechnological invention. The present mandatory conditions are confined to disclosure of the invention in a manner sufficiently clear and complete for inventions to be carried out by a person skilled in the art. In addition, may be required to indicate the best mode of carrying out the inventions known to the inventor at the filing date. India's position is that the objective of CBD could be incorporated through inclusion in Article 29 of provisions requiring a clear mention of the biological source material by indigenous communities in the country of origin. The part of the patent application should be open to full public scrutiny immediately after filing of the application. Such a reconciliation would permit countries with possible opposition claims to examine the application and stake their claims well in time.

The next contradiction is the lack of provision in the TRIPS agreement on prior informed consent of the country of origin and the knowledge holder of the biological raw material meant for usage in a patentable invention. This needs to be reconciled with Article 15.5 of CBD. Thus, if any inventor wants to develop such biological materials, for commercial purpose, he or she would have to get the prior informed consent of the country as well as the owner and, if required by such owner, enter into agreements with the country of origin.

A material transfer agreement would be necessary where the inventor wishes to use the biological material and an transfer of information agreement, where the inventor is basing himself or herself on indigenous or traditional knowledge. India feels that an obligation in the TRIPS agreement to share benefits in this manner should be considered as an effective tool to ensure that the benefits reach the claimant.

In addition, developing countries including India, have voiced concern that with the World Trade Organisations coming into existence, there is fear that non-tariff barriers, in the form of environmental and health criteria, might be erected to keep exports out of developed countries.

As most of India's exports like chemicals, minerals, textiles, leather, tea, coffee, fish and shell fish are "environmentally sensitive" this requires urgent attention. Of particular importance are the changing preferences in Germany, the second largest importer of India goods with a turnover of nearly $ 10 billion. This has gained added importance with recent controversies surrounding German rejection of India tea because of high pesticide residue as well as the German ban on import of textiles coloured with azo dyes. The government including various ministries like the ministry of environment and forests and the ministry of commerce have decided to do the ostrich trick and hope that the problem goes away. Instead of researching changing trends of western consumers, the government had earlier tried to gloss over the issue. At the local level the government has been content with holding seminars on the issue, while at the international level all it has done is to ask for extensions on bans of certain items like in the case of azo dyes. Indian exporters, considered to be quick on the uptake have also been caught on the wrong foot. A survey conducted by the Berlin-based German Development Institute had found most of the Indian exporters had adopted a "wait and watch" policy.[9]

There is no denying that markets in OECD countries are 'greening'. People and governments take the environmental threats more and more seriously and put industries under pressure to adjust. On the one hand, governments and legislatures introduce new environmental laws and regulations affecting not only the production process but also the products themselves. On the other hand, consumers have realised that they can effectively use their purchasing power to influence industry toward lower impact production and toward the development of eco-friendly products.

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[8] The Relationship between the TRIPS Agreement and the Convention on Biodiversity. . November 1997. Ministry of Commerce. Government of India.

[9] Ecological product standards and requirements as a new challenge for developing countries' industries and exports. The case of India's leather, textile and refrigeration industries. German Development Institute. 1994.

There is a whole set of eco-requirements to which industries in both OECD and developing countries have to adjust: Laws and regulations setting health, safety and environmental standards, broader concepts of product liability, international agreements on the reduction or phasing-out of certain substances which are perceived to be harmful to the global commons, e.g. ozone depleting substances like CFCs (chlorofluorocarbons), eco-labels and eco-marketing strategies aiming at ever more conscious consumers of which a small but growing minority are prepared to fundamentally reconsider modern lifestyles which are considered not to be sustainable with respect to energy consumption and material throughput.

Product standards and norms have always played a role in international trade. They are compatible with the GATT, provided they are applied indiscriminately to domestic and imported goods. The GATT accepts eco-labels as well, even if they refer to the environmental quality of process and production methods. Eco-labels leave it to the individual consumer whether he or she is willing to pay a higher price for the compliance with stricter eco-standards of the producers from which he/she buys. Yet, the GATT has not accepted until today that governments use eco-criteria for process and production methods as a means to restrict imports from countries which do not comply with these process standards. However, the pressure on developing countries to comply with higher environmental standards for process and production methods will increase. Developing countries like will be on the safe side if their industries accept more responsibility to reduce their impact on the environment by developing eco-friendly products, adopt lower impact process and production methods and clean their effluents more effectively.

The German study highlighted the problems in the leather and textile industry. Leather tanning is a highly pollutant process. Under German environmental regulations only few tanneries have remained. At the same time, imports from developing countries have filled the gap. With a considerable time lag, these imports have come under scrutiny for their health and environmental quality.

The first issue was the utilisation of the chemical fungicide PCP for the conservation of leather. Germany banned the use of PCP for every industry. This put India's highly export-dependent leather producers under adjustment pressure. The study shows that the Indian leather industry was able to adjust to the PCP ban and will be able to cope with new product-related eco-standards, such as the substitution of formaldehyde and benzidine-dyes.

The support system for India's leather sector consisting of a combination of public and private institutions is able to render the appropriate services, such as export promotion, research and training. Some deficiencies, however, are evident with regard to the controlling and monitoring capacity. Not surprisingly, large companies have a higher adjustment capacity than small companies. In the initial phase of the PCP ban, however, some problems occurred. Although the German side informed India early enough about the ban, the Indian side did not take the information seriously. Neither government nor industry associations, councils or private firms took the initiative early enough by installing testing facilities and replacing PCP.

The next issue could be the introduction of eco-requirements for the production process. Compliance with eco-criteria for process and production methods should not become an insurmountable barrier for India's leather industry. Large-scale investment into the construction of effluent treatment plants is under way, the bottleneck for the medium-term future might be more in the field of skilled personnel for the effective management of the new treatment plants.

Currently, public debate in Germany and in other OECD countries, has increasingly focused on the harmful effects on health and environment of chemicals used in textile finishing but also on the considerable environmental damages from traditional highly chemical-intensive cotton cultivation. Cotton is one of the most chemical intensive crops affecting both soil and ground-water. The textile industry itself is a high consumer and polluter of water. Lack of effluent treatment can cause substantial environmental impacts on rivers and lakes.

Finally, there is a growing awareness that the chemical contamination of textiles can be a health risk for textile workers and consumers. As a result of the heightened public awareness of eco-damages from textiles and textile finishing, there is a growing market share for 'eco-textiles' (which claim to be produced with 'clean cotton', i.e. cotton with low content of harmful chemicals). Even large department stores and mail order houses venture into eco-textiles and find a rising demand for them.

The Indian textile and garment industry, being extremely heterogeneous, has varied levels of awareness and capacity to adjust to new eco-standards differ between the various actors. Direct exporters are in the 'firing line' of the new requirements, willing to comply with the eco-standards but often not able to put pressure on their suppliers. The big textile mills would have the resources to develop alternatives, but with their huge domestic market share, they do not consider the upcoming eco-standards on export markets as an urgent problem. The majority of the decentralised sector, particularly the dyeing and printing units, are neither aware of this problem nor financially and technically capable to comply with the eco-standards in the short run.

The support system for the Indian textile industry is well developed and organised. However, identifying dangerous substances and developing alternatives is a new field of activity for most of the research institutes. Eco-quality control and certification of 'clean' products would be possible in the private sector or by governmental institutions.

There is a growing awareness in India of the seriousness with which eco-standards are being introduced in Germany and the European Community. Despite the increasing awareness of new eco-standards many companies have no detailed knowledge about the environmental impact of particular substances and the health risks caused by their products. The willingness of the three industries to adjust is limited. Most of them stick to the 'wait and see' attitude.

Most of the companies in the organised sector have the financial and manpower capacity to comply with the new requirements. In some cases the availability of the latest technology may be a constraint. The system of institutions supporting industry is well developed and comprehensive, and interaction between the support system and industry seems to be sufficient in general.

It recommends that government of India can support the adjustment to new eco-standards on export markets in several ways:

1. It must remove existing obstacles to efficient manufacturing. This refers in particular to the facilitation of access to the necessary inputs, i.e. access without bureaucratic delays and hassles to imported inputs if they are not available in India or not available in the required specifications and qualities. Backward integration should also be possible whenever an exporting company sees the necessity to assure a high (eco-)quality of inputs from the forward production stages by bringing these stages under its control.
2. The government should take responsibility for the quality of exports in order to make the label 'made in India' a reliable quality label on the international markets. This is not an easy task in a phase when the government has decided to adopt a rather non-interventionist attitude with regard to the affairs of private industry. Export controls are being dismantled to reduce the cumbersome administrative procedures which had prevented exports from flourishing in the past. The risk of non-interventions, however, is that there is too little control over the capacity of individual exporters to continuously meet the quality standards of the export markets.
3. The government could accelerate the process of adjustment by introducing an eco-label of its own which guarantees the same properties of the labelled products as those relevant in the export markets. This could facilitate exporting once the foreign buyers have become confident that the Indian label is reliable because the testing procedures are the same as in their own countries. This confidence building is the only way to prevent the whole export business from being jeopardised by too many eco-quality checks in the importing countries. Introducing an eco-label in India would also contribute to awareness-building among Indian consumers about the environmental properties of the consumer goods they buy. In the long run, consumers and not governments should control the quality of manufactured goods. Once the discrepancy between the quality standards demanded on the export

markets and on the domestic market have been overcome, the consumers can play a key role in guaranteeing a steady export quality level.

4. The government must set and enforce environmental standards vis-à-vis domestic as well as export industries. This is again illustrated by the Indian example. Following the German ban on PCP, India imposed a corresponding ban on PCP. In a similar way, stricter environmental standards could be set for the Indian textile industry to anticipate possible problems on the export markets.

If trade policy conflicts on environmental requirements and standards can be defused or avoided, international trade can become a means to promote a more effective environmental policy in developing countries and to improve their ecological situation. Despite a growing awareness in India of the seriousness with which eco-standards are being introduced in Germany and the European Community, many companies have no detailed knowledge about the environmental impact of particular substances and the health risks caused by their products. Environmental impacts of the production process are only well known where these impacts are evident, e.g. in the case of effluents and workers' safety. The willingness of the these industries to adjust is limited. Most of them stick to the 'wait and see' attitude.

Information. R&D capacity, training facilities, national legislation, control system and the role of consumers are essential. Developed countries should guarantee that the introduction of eco-standards is accompanied by information and technology transfer and that an appropriate transition period is granted to countries respectively companies which do not have the capacity to adjust immediately.

In addition, the government should accelerate the process of adjustment by aggressively pushing the "Ecomark" label scheme which would be comparable to labelled products as those relevant in the export markets. With a appropriate system of "eco-labelling" in place, the government could then have pushed for harmonising of international standards, so that Indian goods are not discriminated against.

However, the sad truth is that while most people believe environmental awareness is on the rise even in India, there appears to be no empirical proof of it on the ground or rather in the market place in India. Nearly six years after an eco-labelling scheme was launched there is not a signal product for sale that carries the insignia of an earthen pot. This symbol is India's "eco-label" which proclaims the products green credentials. This voluntary plan to issue labels for environmentally benign products was mooted in 1991 to encourage the industry to manufacture eco-friendly less waste generating commodities. Could one then conclude that there is neither a market nor a potential for green products. Is our society is inherently anti-environment, or, does not want to put its money where its mouth is?

Despite green concerns becoming a "fad" the reality is quite different. For had their been a market for "eco-labelled" goods, surely all the corporations, with their market surveys would have found out and churned out products to the happy ring of cash registers. Unfortunately, the sad state of the eco-label has come to represent, a unhealthy cocktail of a disinterested urban populace, an uncaring manufacturing sector, and a clueless bureaucracy totally at sea in the midst of a consumer boom. The case of the only product-Ezee detergent-to have got the seal is highly illustrative. Godrej got eco-mark for its Ezee brand in 1993 and soon after sold the brand to the multinational Proctor and Gamble (P&G). P&G decided not to market the product with the seal and allowed its license to lapse. According to industrialists Adi Godrej, taking the eco-label for detergent made sense as its environment-friendly properties stood out. Ezee had substituted the highly polluting phosphorus with another chemical. Arun Vishwanath, manager regulatory and environment affairs for P&G, said that his company had a fundamental objection to the eco-seal type of programmes. "The main problem with eco-seals is that they stifle innovation by codifying current wisdom of what product designs are good for the environment, thereby discriminating against new and better innovations," Vishwanath said. They are also incompatible with fast moving consumer products sector which are characterised by frequent formulation changes. In addition, these seals can be abused to erect international trade barriers, he added. Vishwanath and KP Niyati, head of environment management division of the Confederation of Indian Industry, both feel that the government should move towards a system that encourages a "factual sharing of information with the consumers". Herein, the manufacturer will provide on his product information that proclaim its green credentials. When asked what prevented the companies from giving information voluntarily, Vishwanath said P&G has already started the process.

"We have information about proper disposal on our Whisper sanitary napkin packaging." Perhaps the Indian consumer is ill-prepared at present for these changes. And nothing illustrates this better than the remarks of Tilak Dhar, former co-chairman of FICCI environment and ecology committee, who said it was all a question of demand. Speaking at a seminar on the issue he said: "There is a definitive movement of customer choice towards environment-friendly products. But it is by no means certain that the preference extends to a level which will justify the extra costs associated with making products conform to Ecomark standards." Others dispute this assertion. At same seminar, representative of a consumer group, CUTS, Pradeep Mehta, said a lot of surveys had brought out people's awareness of the environment. "Consumers will pay more if given the choice and quality," he added. Mehta cautioned that the criteria adopted in India was not the best and the companies are likely to run into trouble if they were to export their products. Increasingly, "green consumers" in the developed countries asking for environmentally-benign products for the exporting nations.[10]

In a study, Dr Vasantha Bharucha has examined the impact of a number of international and country-specific environment measures of selected Indian exports.[11]. She survey the refrigeration and air conditioning industry, besides manufacturers of tea, dyes and intermediaries, agriculture products and processed foods, marine products and the leather and textile sectors. She concludes that there is no doubt that Indian exports will confront new problems related to environmental standards set in foreign markets as well as standards set by multilateral agreements. According to her, it would make much more economic sense for India to incur these trade-related environmental costs in the short term to ensure continued access to rich overseas markets over the long term. As India, along with other developing countries have liberalised their economies and pursued trade-related growth there can be no choice but to conform to new environmental standards being set.

CONCLUSIONS

On the whole, the record of progress on the Rio commitments in the area of trade and sustainable development has been poor. Most of the areas where bargains exist are characterised by asymmetrical fulfilment of commitments. Where the bargain was between developed and developing countries, as with financial and other assistance for progress on global environmental issues, the developing countries have gone much further than the developed countries toward keeping up their end of the deal. While they may have reaped environmental benefits from their actions, developing countries have clearly had the hard end of the deal. Where the bargain was economic growth for environmental responsibility, as with the shunning of trade-distorting environmental measures in return for appropriate environmental standards and reduced transborder pollution, the loser has been the environment. These characterisations are subject to many important specific exceptions; they are intended more as a gross portrait of five years' experience than as blanket truths.

The WTO and the GATT before it have made little progress on environmental issues or issues of openness since Rio. As a consensus-based organisation, it has been foundering on the key problem of how to define like goods, and whether to allow countries to discriminate at the border on the basis of how a good is produced. Developing countries, and many developed countries as well, have shied away from allowing such discrimination, fearing green protectionism. Others, mostly in the environmental community, insist hat such distinctions are fundamental to effective environmental policy. Until this gap is bridged the clash between the trade and environment communities will continue, and progress will be postponed in a host of related areas such as MEAs, border tax adjustments, ecolabelling, and market access.

Meanwhile, governments in developing countries such as India need to be proactive. Instead of crying tself hoarse over "new and intrusive clauses" in the form social and environmental considerations acting as

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[0] Singh, Damandeep. The Mark of an Apathetic Society, in The Indian Express, February 24, 1997.

[1] Bharucha, Vasantha, "The Impact of Environment Standards and Regulations Set in Foreign Markets on ndia's Exports. . in Trade Environment and Sustainable Development edited by Veena Jha, Grant Hewison nd Maree Underhill. MacMillan Press Ltd. 1997.

barriers to trade, India would do well to understand the issues involved and act quickly upon them. In order to promote the concept of eco-standards in the country and to make the label "made in India" an international success, the government did introduce an "ecomark" scheme in 1991. It was aimed at accelerating the process of adjustment by introducing an eco-label which guarantees properties similar to those relevant in the export markets. The authorities, in formulating these standards, borrowed heavily from the German and Canadian norms.

This could have facilitated exporting once the foreign buyers become confident that the Indian label is reliable as the norms and testing procedures are the same as in their own countries. This confidence-building exercise would have gone a long way in preventing the export business from being jeopardized by too many eco-quality checks in the importing countries. But the response to the scheme has been abysmal. At the last count only one application had been approved by the Bureau of Indian Standards and not one ecomarked product has hit the market.

The concern for one's health and the local environment is only the starting point. An increasing number of consumers are translating their concern for wider environmental problems into changes of their purchasing behaviour. They respond quickly to the debate about the destruction of tropical forests and reduce their consumption of furniture made from tropical timber. Or they refuse to buy aerosol sprays using choloroflurocarbons or tea which has an excess of pesticide residue.

Germany recently also introduced packaging ordinance which aims at reducing and recycling packaging material as far as possible. Under the scheme an exporter is either obliged to take back packaging that lands up in the customers hands or pay for its disposal in Germany by obtaining a Green Dot license.

Even the German public procurement agencies are encouraged, and even obliged, by specific regulations to take the environmental quality of the products into account and to prefer environment friendly products to others even if they are more expensive. The greening of public procurement would have an increasing impact on international trade if the World Trade Organisation code on public procurement were taken more seriously.

Developing countries' exporters bidding for public contracts in OECD countries will have to take the changes in public purchasing behaviour into account if they want to make an inroad into these markets. It is important that export promotion programmes and aid agencies must take account of the greening of markets in OECD countries and apprise developing countries of the changes taking place.

Ultimately, however, the changes have to be made by exporters and sooner the political leaders channelise their energies towards promoting cleaner products the better it would be for the local population as well as for the country's export performance.

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Final Project Report

Laws on environment and issues of sustainability in Indian context

Submitted by

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ABSTRACT

The project intends to study and analyze the status of environment in the scheme of Constitution of India. The importance granted to protection of environment in the planning process, history and evolution of laws of environment in India specially Water Act, Air Act and Environment Protection Act. Reference was also be made to Environmental policy, Constitutional, Legislative provisions, Procedure for enforcement of Environmental laws alongwith current important judicial pronouncements in this field.

The issues arising out of enforcement of Environmental laws specially the conflict with the local community and the difficulties in enforcement of such laws have been examined. The adequacy of the administrative machinery to enforce the laws was also discussed in detail. Some of the judicial pronouncements have far reaching consequences on the very livelihood and economic activity of the rural masses specially those relating to forest produces, management of coastal areas etc. These pronouncements have brought to fore the conflict between the Government and the various interest groups. Alongwith this, relocation of industries specially in metro cities and towns has adversely affected thousands of industrial workers and involves massive investment.

The sustainability of environmental laws will depend on the successful implementation of pro-environmental measures and the adequacy of financial resources to implement them. The social and political aspects of environmental litigation also form part of the study. In the end, some suggestions/recommendations have been made for harmonizing the effect of environmental law with the socio-political realities prevailing in the Country.

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Chapter - I

The traditional Indian worldview revolved around the predominance of agriculture economy which inherently depended on the basic elements of nature in their most original form. These elements were, Water in the shape of rivers and ponds and the sea, Earth in the form of agriculture fields and forests, Sunlight and Air. No agriculture would have been possible without water, Air, Light and Soil. Since the size of population in those times was small and the natural resources were in abundance, the balance was always positive. And, therefore, the then rulers did not feel the necessity of any law to protect these elements. However, still one finds a reference to management and preservation of forests and wildlife in the Ancient Indian law book Kautilya's Artha Shastra. The law concerning forests enjoined upon the State to maintain forests and to develop new forests. Forest produce was meant to be regulated for common use of the local communities as well as for business and trade. There was specific law prohibiting cutting of trees in city parks and destroying other trees, special attention was paid to the protection of flower and fruit bearing trees. The trees which were worshipped were guarded with greater zeal and respect. The trade in timber was regulated by the king through his functionaries and the forest dues were the property of the soverign. Wildlife was protected, special areas were delimited for their safety. For attacking, killing or injuring wildlife, heavy fines were imposed. Hunting was regulated and confined in specific areas. There is also mention of protection of Wildlife in the fifth Pillar Edict of Ashoka dating back to 264 B.C. Ashoka had forbidden killing of various species of animals, fishing was also prohibited in certain places depending on Lunar movement. Thus, it is clear that in ancient Indian jurisprudence there was a high priority to protection of forest and wildlife.

As long as the economy remained dependent on agriculture alone, the confrontation with nature was minimum and so was environmental degradation. It is only with the advent of industrial mode of production based on technology that the threat to environment has arisen. Technology envisaged mass production and mass consumption of nature's elements as raw materials be it forest, water or minerals. During the Pre-

British days, there is evidence to prove that the local communities enjoyed full control over the forest reserves and other resources. No doubt, the forest belonged to the king its use was determined by local traditions and convention. The Britishers saw India as one of the richest colonies for forest produce and with the expansion of railways, the pressure on forests grew many fold. By the end of the 18th century, the best forest of Europe had been consumed and Indian sub-continent was the only source for England's requirement of timber for ship building and railway expansion. The expansion of railway lines in India saw cutting of forest to meet the demands for sleepers. The extraction of forest produces was unregulated and without any scientific management strategy and the Britishers themselves realised the darker side of devastation of forest in India. In order to meet their long term needs of forest produce vis-à-vis depleting forest resource an attempt was made to have a forest policy which finally resulted in state monopoly over forest through the Indian Forest Act, 1865. This law was amended in 1878, which provided for extraction of forest produce in a scientific manner. The Government demarcated specific areas of forest for its requirement of timber and except the village forest, rest of the forest came under the direct control of the Government. The loss of control over the natural resources resulted in reaction from the local communities specially in tribal areas.

In addition to the strategic interest of railway expansion and requirement of timber during the times of wars, mostly in Europe and Africa, the forest department were also required to generate adequate revenue. After independence, the National Forest Policy was declared by the Government in 1952. It reiterated assertion of State monopoly in the name of national interest and provided for balanced and complementary land use, checking denudation, providing afforestation and increased supplies of fuel, grazing and small timber to the agricultural communities.

Chapter - 2

Status of Environment in the Constitution.

Environmental laws are of very recent origin through out the world and India is no exception to that. Even in U.S.A., the laws on environmental protection were enacted in 1960s and 1970s. Before specific laws of protection of environment were enacted all over the world, the issues relating to the civil or criminal causes which could be related to environment were addressed under the common law and the laws on nuisance and trespass, negligence and the principle of strict liability.

Similarly, in India at the time of framing of the Constitution, there was no entry under any of the three lists i.e. Central list, State list or Concurrent list which directly empowered the Government to legislate on environment. It would be essential to understand the legislative scheme in the Constitution of India. Part-XI provides for the legislative powers of the Union and the States. Article 245 empowers the Parliament to legislate for the whole country and it also empowers the legislatures of the States to make laws for their respective States. Article 246 of the Constitution divides the areas of legislation between the Union and the States. This article reads as under :

" **246. Subject-matter of laws made by Parliament and by the Legislatures of States.** - (1) Notwithstanding anything in clauses (2) and (3), Parliament has exclusive power to make laws with respect to any of the matters enumerated in List I in the Seventh Schedule (in this Constitution referred to as the "Union List").

(2) Notwithstanding anything in clause (3), Parliament, and subject to clause (1), the Legislature of any State also, have power to make laws with respect to any of the matters enumerated in List III in the Seventh Schedule (in this Constitution referred to as the "Concurrent List").

(3) Subject to clause (1) and (2), the Legislature of any State has exclusive power to make laws for such State or any part thereof with respect to any of the matters

enumerated in List II in the Seventh Schedule (in this Constitution referred to as the “State List).

(4) Parliament has power to make laws with respect to any matter for any part of the territory of India not included (in a State) notwithstanding that such matter is a matter enumerated in the State List.

The Union list contains 97 subjects which are under the exclusive legislative domain of the parliament. These include Defense, Foreign affairs, Treaties and Agreement with Foreign countries, Implementation of treaties, Agreements and Convention with foreign countries, Atomic Energy, Inter-state Transport, Railways Shipping and Navigation on inland water ways, Irrigation, Air traffic, Development of oil fields, Mines and Mineral development and Inter state rivers among other subjects. The State legislature have exclusive power under List II i.e. State list to legislate in respect of public order local Government, Public Health and Sanitation, Local Communication Agriculture, Protection of animal life, Water Supply, Irrigation, Fisheries, Land etc. The concurrent List known as List III is an area where both Parliament and Stage Legislature enjoy jurisdiction. The Concurrent List includes subjects such as Prevention of Cruelty to animals, Forests, Protection of Wild Life and Birds, Shipping and Navigation on inland water ways, Factories, Electricity etc. Parliament has also the residual powers to make laws on any of the subject not covered under the above lists. Another unique feature of the Indian Constitution is that Parliament can also make law in respect to of a matter in the State List if the national interest so desires. Article 249 contains this provision which is reproduced below :

“**249. Power of Parliament to legislate with respect to a matter in the State List in the national interest** - (1) Notwithstanding anything in the foregoing provisions of this Chapter, if the Council of States has declared by resolution supported by not less than two-thirds of the members present and voting that it is necessary or expedient in the national interest that Parliament should make laws with respect to any matter enumerated in the State List specified in the resolution, it shall be lawful for Parliament to make laws for the whole or any part of the territory of India with respect to that matter while the resolution remains in force.

(2) A resolution passed under clause (1) shall remain in force for such period not exceeding one year as may be specified therein :

Provided that, if and so often as a resolution approving the continuance in force of any such resolution is passed in the manner provided in clause (1), such resolution shall continue in force for a further period of one year from the date on which under this clause it would otherwise have ceased to be in force.

(3) A law made by Parliament which Parliament would not but for the passing of a resolution under clause (1) have been competent to make shall, to the extent of the incompetency, cease to have effect on the expiration of a period of six months after the resolution has ceased to be in force, except as respects things done or omitted to be done before the expiration of the said period."

The Constitution of India as such had been silent on the question of environmental laws. However, the subjects which have bearing on the environment such as forest, fisheries, water ways, water bodies, wild life were included in different lists depending upon the situation.

It is only in the year 1976 when Forty second amendment was passed that new article was added to the Dorectove Principles of State Policy. This article cast the duty on the State to improve the environment. Article 48 A is reproduced as under :

"**48-A. Protection and improvement of environment and safeguarding of forests and wild life** - The State shall endeavour to protect and improve the environment and to safeguard the forests and wild life of the country."

Another important development a new chapter on fundamental duties was included as PART-IV A and Article 51-A was incorporated in the Constitution of India.

"**51-A. Fundamental duties.** - It shall be the duty of every citizen of India -

(a) to abide by the Constitution and respect its ideals and institutions, the National Flag and the National Anthem;

(b) to cherish and follow the noble ideals which inspired our national struggle for freedom;

(c) to uphold and protect the sovereignty, unity and integrity of India;

(d) to defend the country and render national service when called upon to do so;

(e) to promote harmony and the spirit of common brotherhood amongst all the people of India transcending religious, linguistic and regional or sectional diversities; to renounce practices derogatory to the dignity of women;

(f) to value and preserve the rich heritage of our composite culture;

(g) to protect and improve the natural environment including forests, lakes rivers and wild life, and to have compassion for living creatures;

(h) to develop the scientific temper, humanism and the spirit of inquiry and reform;

(i) to safeguard public property and to abjure violence;

(j) to strive towards excellence in all spheres of individual and collective activity so that the nation constantly rises to higher levels of endeavour and achievement."

Clause (g) of Article 51-A imposes duty on every citizen to protect the natural environment including forest, lakes, rivers and wild life and to have compassion for living creatures. These two articles namely; 48-A and 51-A(g) reflect the concern and consensus on the issue of environmental protection and its improvement.

The importance of Article 48-A and Article 51-A(g) have been reiterated by Courts in the past. In Sachidanand Pandey V. State of west Bengal, AIR 1987 SC 1109, 1114-1115, the Supreme Court has held :

> " Wherever a problem of ecology is brought before the Court, the Court is bound to bear in mind Art. 48 A of the Constitution ... and Art. 51 A(g).... When the Court is called upon to give effect to the Directive Principle and the fundamental duty, the Court is not to shrug its shoulders and say that priorities are a matter of policy and so it is a matter for the policy-making authority. The least that the Court may do is to examine whether appropriate considerations are borne in mind and irrelevancies excluded. In appropriate cases, the Court may go further, but how much further will depend on the circumstances of the case. The Court may always give necessary directions. However the Court will not attempt to nicely balance relevant considerations. When the question involves the nice balancing of relevant considerations the Court may feel justified in resigning itself to acceptance of the decision of the concerned authority."

Similarly, the Andhra Pradesh High Court in T. Damodar Rao V. The special Officer, Municipal Corporation of Hyderabad, AIR 1987 AP 171, 181 has held that Article 48 A imposes an obligation on the Government, including Court to protect the environment.

In the absence of specific entry in any of the three lists, to legislate on the general issues relating to environmental laws, the Govt. of India has taken recourse to the provision of Article 253 for enacting various environmental laws such as Water (Prevention and Control of Pollution) Act, 1974; Air (Prevention and Control of Pollution) Act, 1981 and the Environment (Protection) Act, 1986. Article 253 of the Constitution reads as under :

"253. **Legislation for giving effect to international agreements** . Notwithstanding anything in the foregoing provisions of this Chapter, Parliament has power to make any law for the whole or any part of the territory of India for implementing any treaty, agreement or convention with any other country or countries or any decision made at any international conference, association or other body."

All the three environmental legislatures have been enacted in due implementation of decisions reached at United Nation's Conference on Human Environment held at Stockholm in 1972.

It would be interesting to compare the evolution of Environmental Legislation in U.S.A. Like in India, even in U.S.A. the specific Environmental Legislation on Prevention of Air Pollution, Water Pollution and management of hazardous waste is of very recent origin.

The Safe Drinking Water Act was enacted in 1974 to provide for safe drinking water, protect aquifers and protect drinking water from contamination by the underground injection of waste. On 21st October 1976, Congress enacted Resources, Conservation and Recovery Act to deal with the problem of solid waste specially hazardous waste. The Toxic Substance Control Act was passed in 1976 which require testing of chemical substances both new and old entering the environment and to regulate them where necessary.

The first Clean Air Act was passed in 1963 and was subsequently amended in 1970 and finally in 1977. The act provided for control of emission into the air and its harmful effects. Water Control Act was enacted in 1972 and modified in 1977 to deal with toxic water pollutant and was remanded as Clean Water Act. Occupational Safety and Health Act was enacted in 1970 and so was National Environment Policy Act in 1970.

From the above it is seen that in U.S.A. as well as in India, had recent and similar beginnings in the field of environment legislation but there is a lot of difference at the level of implementation and the response there to.

Chapter - 3

ENVIRONMENTAL LEGISLATION

As anywhere in the world, in India too, the problems of environmental pollution have a direct relation with the developmental process. The efforts to boost progress and bring prosperity have put extreme pressure on the industrial resources available in the country. Enlargement of irrigation facilities have resulted in rising levels of salinity, and degradation of soil quality. Industrial development has been a major factor in polluting air and water. Extension of housing facilities and the provision of shelter for all have taken away substantial chunk of land which could have otherwise been put to agriculture use. An estimated 100 million hectares of land, almost one-third of total area, now stands affected by soil degradation, erosion, salinity, alkalinity and wind erosion. The requirements of fuel and fodder and development of roads, water reservoirs have resulted in deforestation which has further affected availability of water exhibiting an alternating cycle of flood and droughts. Untreated human wastes in towns and cities and domestic discharges have contaminated the quality of surface and ground water. The overall picture is dismal and horrendous. Take a look at the statistics of National Capital of Delhi which reveals a very disgusting scenario. Every day approximately 2000 million litres of waste water and 132 M.T. of B.O.D. are discharged into the river Yamuna of which industries contribute only 15% and the rest is from the domestic sector. An estimated 2000 M.T. of pollutants are emitted in the atmosphere every day by vehicles, thermal power plants, industries and domestic coal burning. Carbon monoxide tops the list of pollutants with an estimated emission of 1063 M.T. per day followed by Nitrogen dioxide 179 M.T. Vehicular sources contribute about 64% of the total pollutants emitted followed by thermal power plants 16%, Industry 12% and domestic sector 7%. Solid waste pollution is equally alarming with Municipal waste generation reaching 4000 M.T. per day and fly ash from power plants 5600 M.T. per day. This waste is presently dumped at various sites accept 100 M.T. of fly ash being used by Cement Corporation of India. The situation is no better in other metros and town.

Government of India has enacted several laws for the protection of forests and environment and for the prevention of air and water pollution and there are also proposals to enact more laws to deal with environmental problems more effectively. The position regarding the laws enacted/proposed is briefly discussed below.

1. The Indian Forest Act, 1927

This Act was enacted to preserve and safeguard the forests generally in India. The Act contains various provisions for conservation of forests and also provides for the constitution of any forest lands or waste lands which are the property of the State Government, a reserved forest. It deals with Reserved Forests, 'Village Forest', 'Protected Forests' and 'Forest of Private Owners'. It has not undergone any amendments to bring it into conformity with the forest policy of the Government, particularly the policy contained in the Ministry of Food and Agriculture Resolution No.13-/52F dated 12th May 1952. It is now proposed to amend this Act so as to bring it is conformity with the 'National Forest Policy, 1988'. Government of India has already circulated a draft amendment to the States. A Committee was also set up to examine the existing legislation, and suggest necessary modifications, as bulk of the forests in the North Eastern region are not owned by the Government. The Committee has submitted its report which is under consideration.

2. The Forest (Conservation) Act, 1980

The purpose of the Act is to check indiscriminate dereservation and diversion of forest land for non-forest purposes. The State Governments are required to submit formal proposals for declaration of reserved forest as deserved, and for diversion of forest land for non-forest purposes, to the Ministry of Environment & Forest for approval. The Act envisages constitution of an Advisory Committee by the Central Government of such persons as it may deem fit to advise it regarding the grant of approval to the State Governments and any other matter connected with the conservation of forests which the Central Government may refer to it.

3. The Wildlife (Protection)Act, 1972

This Act provides for the protection of wild animals and birds and for matters connected therewith or ancillary thereto. The Act also provides for notification of 'Sanctuaries', 'National Parks', 'Game Reserves' and 'Closed Areas' by the State Government.

4. The Water (Prevention and Control of Pollutuion) Act, 1974

This law was enacted in pursuance of Clause(1) of Article 25? of the Constitution of India to provide for the prevention and control of water pollution and the maintenance or restoration of wholesomeness of water. The purpose of this Act is to ensure that the rivers, streams and other sources of drinking water and water for support of fish life and for use in irrigation are not allowed to be polluted by the discharge of domestic and industrial effluents. The Act envisages establishment of a Central Board for the Prevention and Control of Water Pollution and also State Boards to deal effectively with the problem of water pollution in the country, and provides deterrent 'penalties for contravention of the provision of Act. The Act also provides for setting up of Central and State Water testing laboratories to enable the Boards to asess the extent of pollution, lay down standards and establish guilt or default.

This Act was amended in 1978 to remove certain practical difficulties faced in its implementation. It was further amended in 1988 renaming the Boards as Central/State Pollution Control Boards so that they may deal with both water an air pollution control. The Central Board was empowered to perform the function of the State Board in certain situations, and penal provisions were made stricter. Boards were given powers to give directions including direction for closure or stoppage of water and electricity supply and other services to the offending establishments. The amendment enabled citizens to file criminal complaints against offenders after giving 60 days' notice to the Board, and the Boards have to furnish all relevant information to the complainants. The courts were empowered to pass ex-parte orders to take urgent remedial action, where circumstances so warrant. Obtaining consent of the Board was made obligatory at the time of establishing an industrial unit.

5. The Air (Prevention and Control of Pollution)Act, 1981

This law had been enacted in pursuance of the decisions taken in the U.N. Conference on Human Environment held in Stockholm in June 1972 (in which India participated), the appropriate steps would be taken for the preservation of the natural resources of the earth which, among other things, include the preservation of the quality of air and control of air pollution. The presence in the air, beyond certain limits, of various pollutants discharge through industrial emissions and from certain human activities connected with traffi heating, use of domestic fuel, refuse, incineration, etc., has detrimental effects on th health of the people as also on animal life, vegetation and property. The Act envisages a integrated approach for tackling such problems. It provides that the Central and the Stat Boards set up for the prevention and control of water pollution under the Wate (Prevention and Control of Pollution) Act, 1974 shall perform the functions in respect o prevention, control and abatement of air pollution also.

The Act was amended in 1987 to make its implementation more effective. In fact the amendments made in this Act in 1987 were substantially incorporated in the Water (Prevention and Control of Pollution) Act in 1988 also.

These two Acts provide for a consent system for control of pollution at source before the pollutants are discharged into the environment. It is the statutory obligation o the party to obtain the consent of the Pollution Control Board in regard to the qualit quantity and location of discharge point of its omissions.

These Acts are being administered by the Central and State Pollution Contro Boards/Committees.

6. The Water (Prevention and Control of Pollution) Cess Act, 1977

This law was enacted to provide for levy and collection of access on water consumed b persons carrying on industries and by local authorities, with a view to augmenting th resources of the Central Pollution Control Board and the State Pollution Contr Board/Committee.

The water cess collected in various States under the Act is transferred to th Consolidated Fund of India. Ninety per cent of the collected cess is reimbursed to th State Pollution Control Boards for their activities. As this procedure causes delay i distributing funds to the State Governments, it is now proposed that the Stat Governments would collect the cess, and after deducting the share amount, they woul directly deposit the balance amount with the Consolidated Fund of India under intimation to the Ministry of Environment & Forests.

The Act is being amended with a view to augmenting the resources of the Pollution Control Boards by removing the lacunae in the Act and 'to provide rebate to the industries for complying with the consumption and effluent quality standards'. The Water (Prevention and Control of Pollution) Cess (Amendment) Bill, 1991 has already been passed by both the Houses of Parliament.

7. The Environment (Protection) Act 1986

This is a general legislation on environmental protection which, inter alia, should enable coordination of activities of the various regulatory agencies, creation of an authority or authorities with adequate powers for environmental protection, regulation of discharge of environmental pollutants and handling of hazardous substances, speedy response in the event of accidents threatening environment and deterrent punishment to those who endanger human environment, safety and health. The Act empowers the Central Government to take all such measures as it deems necessary or expedient for the purpose of protecting and improving the quality of the environment and preventing, controlling and abating environmental pollution. The Central Government has been further empowered, in the exercise of its powers and performance of its functions under this Act, to issue directions in writing to any person, officer or any authority; and such person, officer or authority shall be bound to comply with such directions. The Act envisages establishment/recognition of environmental laboratories and appointment/recognition of Government Analysts for the purpose of analysis of samples of air, water soil or other substances sent for analysis to any environmental laboratory established or recognized under the Act.

The Ministry of Environment & Forests has taken several measures for implementation of the provisions of this Act, including framing of rules, notification of standards and environmental laboratories, identification of agencies for hazardous chemical management and setting up of Environmental Protection Council in the States.

The Central Government has, under this Act, empowered the Central Pollution Control Board to enter any place and inspect any equipment, industrial plant, record, register, document or any other material object under sub-section(i) of Section 10 and to take samples of air, water, soil or any other substance for the purpose of analysis, from any factory or premises or other places under sub-section(i) of Section 11 of the Act.

8. The Public Liability Insurance Act, 1991

This law has been enacted to provide for public liability insurance for the purpose of providing immediate relief to the persons affected by accident occurring while handling any hazardous substances and the matters connected there with or incidental thereto. The Act came into force with effect from the 1 April 1991. The Rules under this Act were notified on the 1 May 1991, and other notifications under various provisions of the act have also been issued.

Chapter - 4

INSTITUTIONAL FRAMEWORK FOR IMPLEMENTATION OF ENVIRONMENTAL LAWS - AIR ACT/WATER ACT.

There are elaborate arrangements under Air Act and Water Act establishing the implementation of environmental laws. The Central Pollution Control Board (CPCB) has been set up in September 1974 under the Water (Prevention and Control of Pollution) Act, 1974. Most of the respective State have adopted the Act and constituted respective State Control Boards. These Boards have also been entrusted with the responsibility of Air pollution control under the Air (Prevention and Control of Pollution) Act 1989.

The objectives of these Boards are securing effective control of water and air pollution in order to maintain and restore, wherever necessary, the wholesomeness of water for various designated best uses and to preserve the quality of air as per the requirements of ambient air quality.

Besides control of water and air pollution ,the CPCB co-ordinates the activities of the State Boards and provides technical assistance and guidance to them, organizes training programmes, mass awareness programmes, and dissemination of information in respect of matters relating to water and air pollution and their prevention and control. The CPCB also advises the Central Government on all such matters.

The State Boards perform similar functions at the State Level. They advise the State Government about the suitability of any premises or location for carrying on any industry which is likely to pollute a stream or well or cause air pollution. These Boards also:

(a) lay down standard for treatment of sewage and trade effluents and emissions from automobiles, industrial plants or any other polluting source;

(b) evolve efficient methods of disposal of sewage and trade effluent on lands;

(c) develop reliable and economically viable methods of treatment of sewage, trade effluent and air pollution control equipment; and

(d) assess the quality of environmental water and ambient air and inspec wastewater treatment installations, air pollution control equipment's, industrial plants or manufacturing processes to evaluate their performance and take steps for the prevention, control and abatement of air and water pollution.

Corporate nature of the Board. -- Clause (3) confers on the Board a Corporate status. The Board is, thus, a corporation or a body corporate, as expressed in Clause (3).

A corporation is an artificial person established for preserving, in perpetual succession, certain rights, which being conferred on natural persons only would fail in process of time. The Board is a corporation in aggregate, consisting of several members in contrast to a corporation sole when consisting of one person only. A corporation comes into existence, in England, either by a Royal Charter or by an Act of the Parliament. India, being a democratic republic, a corporation comes into existence by or under the authority of an Act. The Act confers on it a legal immortality and a name by which it acts and becomes known. This legal immortality is synonymised by the expression perpetual succession.

A corporation may either be spiritual, that is, created to perpetuate the rights or a religious denomination, or civil, created for any secular or temporal purpose, or eleemosynary, that is, for perpetuating the founder's charity. The Board is, thus, a civil corporation.

Generally, a corporation has the power to make bye-laws for its own government. The Act has not enacted any such provision giving power to the Board to frame bye-laws, though power to frame Regulations has been conferred on the Board, under Section 14 (3), so as to prescribe the scales of pay and conditions of service of its employees other than the Member Secretary. Sections 53 and 54 of the Act have given power respectively to the Central Government and the State Government to frame rules in relation to the matters enumerated under those sections.

The duty of a corporation is to answer the ends of its incorporation. The duties of the Board have been clearly defined by the provisions of the Act.

Central Board to exercise the powers and perform the functions of a State Board in the Union Territories. - The Central Board shall exercise the powers and perform the functions of a State Board under this Act for that Union Territory :

Provided that in relation to any Union Territory the Central Board may delegate all or any of its powers and functions under this section to such person or body of persons as the Central Government may specify.

The Section contemplates that no State Board is necessary for a Union Territory. The provision simply is that in relation to a Union Territory, the Central Board, that is the Central Pollution Control Board constituted under Section 3 of the Water (prevention and Control of Pollution) Act, 1974 shall exercise the powers and perform the functions of a State Board under this Act for that Union Territory.

The Provision to the Section states that in case of any Union Territory, it is within competence of the Central Board to delegate all or any of its powers and specify. It follows that whether a delegation has at all to be made, is the sole discretion of the Board who should intimate its option so to delegate, to the Central Government who shall, then, specify the person or body of persons fit to bear the delegation, and on such specification being made, the Board can delegate any of its powers or functions in favour of the person or body of persons so specified by the Central Government.

The Board chooses to delegate, and lest this delegation should become arbitrary in favour of any person or body of persons, power has been reserved unto the Central Government to specify the person or persons in favour of whom the delegation can be made. Though the Central Government may specify in advance the person or body of persons as the donee of such delegation, yet the ultimate choice to delegate or not to delegate is vested in the Board. Again, the Board may choose to delegate, yet the Central Government may nullify such choice by declining to specify the person or body of persons for purpose of delegation. All these possibilities of rancidity between the Board and the Central Government are evident from the unwitty drafting of the Proviso.

Any person aggrieved by the order made by the State Board under the Act may, within thirty days from the date on which the order is communicated to him, prefer an appeal to such authority, referred to as the Appellate Authority, as the State Government may think fit to constitute.

However, the Appellate Authority may entertain that appeal after the expiry of the said period of thirty days if such authority is satisfied that the appellant was prevented by sufficient cause from filing the appeal in time.

The form, the manner in which the appeal has to be preferred and the fees payable for the appeal would be such as may be prescribed by the Rules. The appeal shall be disposed of after notice and hearing afforded to the State Board. Rest of the procedure would be such as may have been prescribed by the Rules.

Chapter - 5

COASTAL ZONE MANAGEMENT

The physical regime of the Indian Coastline is characterized by different types of coastal and shore feature like sandy spils, barrier beaches, embankments, estuaries and offshore islands. These characteristic features are the results of geological and geomorphologic history of the coastline. The physical character of the river mouths are influenced by the behavior of the streams/rivers.

Coastal zone management differs from other forms of land uses in several water area - an area with high potential for new types of resources development, where recovery of Oceanic and sea-bed resources involves utilization of recently developed and rapidly changing technologies whose reliability and eventual consequences are not understood well. Moreover, coasts are often regions of hazards and they contain large proportions of the world's most productive, fragile, science and recreationally valuable ecosystems. The task of devising management systems which take into account such special characteristics is further complicated by a general rapid, often uneven, growth in coastal population. Hence, the principal aim of the coastal zone management is to restore or preserve valued coastal resources without increasing the burden of natural or man-made stresses to a point where either the physical environment of its users suffer serious loss.

The Ministry of Environment and Forests undertook an exercise with regard to the protection and development of the coastal areas. It invited objections against the declaration of the coastal stretches as Regulation Zones and imposing restrictions on industries, operations and process in the Regulation Zones.

After considering all the objections, the Central Government issued a Notification dated 19-02-1991 in exercise of the powers conferred on it by clause (d) of sub-rule (3) of Rule 5 of the Environment Protection Rules, 1986. By this Notification, it declared the coastal stretches of seas, bays, estuaries, creeks, rivers and backwards which were influenced by tidal action (in the landward side) upto 500 meters from the High Tide Line (hereinafter referred to as "HTL") and the land between Low Tide Line (hereinafter referred to as "LTL") and HTL as Regulation Zones. With regard to this area, it imposed, with effect from the date of the said Notification, various restrictions on the setting up and expansion of industries, operation or process etc. In the said Regulation Zones. It was clarified that for the purpose of the main Notification HTL was defined as the line up to which the highest high tide reaches at springtime.

The salient features of the main Notification are that a number of activities were declared as prohibited in the Regulation Zones, which are as follows.

i) " Setting up of new industries and expansion of existing industries, except tho directly related to water front or directly needing foreshore facilities.

ii) manufacture or handling or storage or disposal of hazardous substances as specifi in the Notification of the Government of India in the Ministry of Environment a Forests No. SO 594(E) dated 28-07-1989, SO 966(E) dated 27-11-1989 and GS 1037(E) dated 05-12-1989;

iii) setting up and expansion of fish processing units including warehousing (excludin hatchery and fish drying permitted areas).

iv) setting up and expansion of units mechanisms for disposal of wastes and effluenc except facilities required for discharging treated effluence into the watercourses wit approval under the Water (Prevention and Control of Pollution) Act 1974, except fo storm water drains.

v) Discharge of untreated wastes and effluents from industries, cities or towns an other human settlements, schemes shall be implemented by the authoriti concerned from phasing out the existing practices, if any, within a reasonable tim period not exceeding three years from the date of this Notification.

vi) dumping of city or town wastes for the purposes of landfilling or otherwise, t existing practice, if any shall be phased out within a reasonable time not exceedi three years from the date of this Notification;

vii) dumping of ash or any wastes from thermal power stations.

viii) land reclamation, bunding or disturbing the natural course of sea water with sim obstructions, except those required for control of coastal erosion and maintena or clearing of waterways, channels and ports and for prevention of sandbars and a except for tidal regulators, storm water drains and structures for prevention salinity ingress and for sweet water recharge;

ix) mining of sands, rocks and other substrata materials, except those rate minerals available outside the CRZ areas;

x) harvesting or drawl of groundwater and construction of mechanisms therefore, within 200 m of HTL; in the 200 m to 500 m zone, it shall be permitted only when done manually though ordinary wells for drinking, horticulture, agriculture and fisheries;

xi) construction activities in ecologically sensitive areas as specified in Annexure-I of the Notification.

xii) any construction activity between the Low Tide Line and High Tide Line except facilities for carrying treated effluents and waste water discharges into the sea, facilitates for carrying sea water for cooling purposes, oil, gas and similar pipelines and facilities essential for activities permitted under this Notification; and

xiii) dressing or altering of sand-dunes, hills, natural features including landscapes changes, 50 percent of the plot size and the total height of construction shall not exceed 9 meters."

The main Notification also provides for regulation of permissible activities. The coastal States and Union Territory Administrations are required to prepare, within one year from the date of the main Notification, Coastal Zone Management Plans identifying and clarifying the Regulation Zones area within their respective territories in accordance with the guidelines contained in the main Notification and those plans are required to be approve. with or without modification, by the Central Government, Ministry of Environment and Forests, Government of India, are to be regulated by the State Government, Union Territory Administration of the local authority, as the case may be, in accordance with the guidelines contained in Annexure-I and II of the main Notification.

Anticipating that it will take time till the Management Plans are prepared and approved, the main Notification provided that till the approval of the Management Plans, "all development and activities within CRZ shall not violate the provisions of this Notification".

As already noticed ,there are two annexures, namely Annexure-I and Annexure -II to the main Notification. While Annexure-I contains the Coastal Area Classification and Development Regulations which are for general application, Annexure-II is the specific provision which contains the guidelines for development of beach resorts/hotels in the designated areas of CRZ III for temporary occupation of tourists/visitors with prior approval of the Ministry of Environment and Forests.

Annexure - I consists of clause 6(1) which relates to the classification of Coastal Regulation Zones. The norms for regulation activities in the said zones are provided by clause 6(2) for regulating development activities. The coastal stretches within 500 meters of HTL of the landward side are classified under clause 6(1) into four categories, which are as under :

a) Category I (CRZ I) includes the areas that are ecologically sensitive and important such as national parks/marine parks, sanctuaries etc. Areas reach in genetic diversity areas likely to be inundated due to rise in sea level consequent upon global warming and such other areas as have been declared by the Central Government or the authorities concerned at the State/Union territory level from time to time. In addition thereto, CRZ I also contains the area between the LTL and the HTL.

b) Category II (CRZ II) consists the areas that have already been developed upto or close to the shore line. This is the area which is within the municipal limits or in other legally designated urban areas which is already substantially built up and which has been provided with drainage and approach roads and other infrastructure facilities, such as water supply and sewerage mains.

c) Category III (CRZ III) is the area which was originally undisturbed and includes those areas which do not belong either to Category I or Category II. CRZ III includes coastal zone in the rural areas (developed and undeveloped) and also areas within the areas which are not substantially built-up.

d) Category IV (CRZ IV) contains the coastal stretches in the Andaman and Nicobar Lakshadweep and small islands except those designated as CRZ I, CRZ II or CRZ III

Clause 6(2) of Annexure I provides for norms for regulation of activities in CRZ I, II, III and IV. With regard to CRZ I, the norms for regulation of activities do not permit new construction within 500 meters of the HTL. Furthermore, practically, no construction activity is allowed between the LTL and HTL. The norms for regulation of activities in CRZ II relate to construction or reconstruction of the buildings within the said zone.

With regards to CRZ II the norms for regulation of activities, inter alia, provides that the area up to 200 meters from the HTL is to be earmarked as "No Development Zone". The only exception is that there can be repairs of existing authorized structures but, the permissible activity in this zone is for its use for agriculture, horticulture, gardens, pastures, etc. The norms further provide for development of vacant plots between 200 and 500 meters of HTL in designated areas of CRZ III within prior approval of the Ministry of Environment and Forests for construction of hotels/beach resorts for temporary occupation of tourists/visitors subject to the conditions as stipulated in the guidelines in Annexure II.

In CRZ IV also, detailed norms for regulation of activities are provided in the said clause 6(2) of Annexure I.

As already noticed, Annexure II contains the guidelines for development of beach resorts/hotels in the designated areas of CRZ III for temporary occupation of tourists/visitors. The vacant area beyond 200 meters in the landward side, even if it is within 500 meters of the HTL can be used, after obtaining permission, for construction of beach resorts for tourists/visitors. There was no provision for allowing any fresh construction within 200 meters of the HTL or within the LTL and HTL. The Clause 7(1) of the main Notification which comes under Annexure - II contains various conditions which have to be fulfilled before approval can be granted by the Ministry of Environment and Forests for the construction of beach resorts/hotels in the designated area of CRZ III.

The above Notification, however was not implemented by various State Governments in letter and spirit and Public interest litigation followed. Subsequently Government of India appointed a Committee headed by Shri. B.B.Vora to suggest some amendments in the said Notification which related mainly to rationalize the limits for development zone and regulating the other construction activities. Some of the recommendations of Vora Committee was accepted by Government of India and amended Notification was issued on 18-08-1994 allowing Government to relax the condition of no development zone within 200 meters from HTL, relaxing the no development zone for river, creeks and that waters from 10-0 meters to 50 meters and allowing basements and green and barbed wire fencing within 200 meters zone from HTL. These amendments came up for adjustments before Supreme Court in case Indian Council for Enviro-Legal, Action V/s Union of India (1996) 5, SCC, and Supreme Court quashed the provisions authorizing Central Government to relax the conditions of no development zone within 200 meters from HTL. However, other amendment were upheld by the Court. The Court also issued directions to the State Government to constitute Coastal Management Authorities in each State or Zone.

Chapter - 6

ENVIRONMENTAL LAW AND THE JUDICIAL PROCESS.

Having discussed the position and origin of Environmental laws in the Constitution, the next question is the nature and status of rights of an ordinary citizen under these laws. Is it a legal right under the law or is 'safe and pure environment' something more than an ordinary legal right or is it a fundamental right of a citizen. This question has been debited differently at different times and looking back on the evolution of judicial pronouncements in related matters, one finds that till recent times, it has been granted a status of an ordinary right under the law. The remedies which have been available to the citizen have been confined to (1) Law of torts or law on Prevention of Nuisance. Naturally, this also covers the remedies of damages and injunction. In some cases related to nuisance or negligence the principles of strict liability have also been enforced.

Compensation the principles involved

The law of torts takes care of the cases where the cause of action arises out of negligence, and strict liability. The remedy of damages and injunction is available . The degree of compensation varies with the degree of the seriousness of the violation and the degree of the damages. As is common under the Civil law, the intention is restitution of the damage than punishment. Therefore in this case effort is made by Court to arrive at fair and responsible compensation for the injury caused. In the past, damages have been very low and the polluters have been merely violating the statute. Judiciary have been serious in this regard and has also awarded exemplary damages which had a very salutory effect in overall enforcement of environmental laws. A lan-mark judgment in this regard had been Shriram Gas Leak Case, M.C. Mehta V. Union of India, AIR 1986, SC 1086 popularly known as Oliem Gas Leak Case. In this case the Court observed that compensation must be correlated to the magnitude and capacity of the enterprise because such compensation must have a deterrent effect. This principal was recently reiterated by the Supreme Court in another case Indian Council For Enviro-Legal V. Union of India and others, (1996) 3 Cases SCC 212. In this case, the Supreme Court held as under :

"Any principle evolved in this behalf should be simple, practical and suited to the conditions obtaining in this country. According to the rule laid down by the Constitution Bench of the Supreme Court in Oleum Gas Leak case, once the activity carried on is hazardous or inherently dangerous, the person carrying on such activity is liable to make good the loss caused to any other person by his activity irrespective of the fact whether he took reasonable care while carrying on his activity. The rule is premised upon the very nature of the activity carried on. In the words of the Constitution Bench, such a activity".. can be tolerated only on condition that the enterprise engaged in such hazardous or inherently dangerous activity indemnifies all those who suffer on account of the carrying on of such hazardous or inherently dangerous activity regardless of whether it is carried on carefully or not. : The Constitution Bench has also assigned the reason for stating the law in the said terms. It is that the enterprise (carrying on the hazardous or inherently dangerous activity) alone has the resource to discover and guard against hazards or dangers - and not the person affected and the practical difficulty (on the part of the affected person) in establishing the absence of reasonable care or that the damage to him was foreseeable by the enterprise. The Bench also observed that such liability is not subject to any of the exceptions which operate vis-à-vis the tortious principle of strict liability under the rule in Rylands V. Fletcher. The twin tests laid down in Rylands V. Fletcher - apart from the proof of damage to the plaintiff by the act/negligence of the defendants - which must be satisfied to attract its rule are 'foreseeability' and 'non-natural' user of the land. The observation of Ranganath Misra, C.J. in his concurring opinion in Union Carbide Corpn. case that the view declared in Oleum was only obiter cannot be accepted. It does not appear to be unnecessary for the purposes of that case. Thus the law stated by the Supreme Court in Oleum Gas Leak case is by far the more appropriate one - apart from the fact that it is binding."

On the same principles, the Supreme Court had in the Bhopal Gas Tragedy case determined the payment of compensation ranging from RS.50,000/- to Rs. 2.00 Lakhs. The abstract of the Supreme Court judgment in the case are produced below :

> "Under the scheme framed under the Bhopal Act, the claims relating to death and personal injuries have been divided into four categories (a) death; (b) total disablement resulting in permanent disability; (c) permanent partial disablement; and (d) temporary partial disablement. The said categories can be made the basis for the determination of quantum of interim payment of damages payable in respect of each of such categories.
>
> As mentioned earlier, the measure of damages payable by the alleged tort-feasor as per the nature of tort involved in the suit has to be correlated to the magnitude and the capacity of the enterprise because such compensation must have a deterrent effect. We have on record the fact that the defendant-UCC is a financially sound corporation having more than 6.5 billion dollars (i.e. Rs.8515 crores) worth of unencumbered asset and 200 million dollars (i.e. about Rs.262 crores) worth of insurance coverage. From the material on record, there is good reason to believe that the insurance coverage covered the risk in respect of claims arising out of the Bhopal disaster also.
>
> Bearing in mind the above said factors, in the opinion of this Court, it would not be unreasonable to assume that if the suit proceeded to trial the plaintiff-Union of India would obtain judgment in respect of the claims relating to deaths and personal injuries at least in the following amounts - (a) Rs.2 lakhs in each case of death; (b) Rs. 2 lakhs in each case of total permanent disability; (c) Rs. 1 lakh in each case of permanent partial disablement, and (d) Rs. fifty thousand in each case of temporary partial disablement."

Remedy under Criminal Law

Another interesting area pertains to judicial remedy under criminal law i.e., Section 133 of code of criminal Procedure where remedial action can be taken against public nuisance. The relation between Section 133 of CrPC and the Air Act of 1981 and Water Act of 1974 was examined by the Andhra Pradesh High Court in Nagarjuna Paper Mills Limited V. Sub- Divisional Magistrate and Divisional Officer, Sangareddy. In this Case, the Court upheld the power of the Executive Magistrate to initiate independent action under 133 Cr.P.C. in addition to the remedies under Pollution laws and their implementation by State Control Board. Interestingly, the Magistrate's power under Section 133 of Cr.P.C. came under scrutiny of the Supreme Court in Municial Council Ratlam V. Vardhichand, AIR 1980 SC 1622. In this case another point of law relating to the liability of the elected local bodies, to take remedial action for prevention of nuisance also came up. In this case, Supreme Court held as under:

> "(Section 133, Cr.P.C. is categories, although reads discretionary. Judicial discretion when facts for its exercise are present, has a mandatory import. Therefore, when the Sub-Divisional Magistrate, Ratlam, has, before him, information and evidence, which disclose the existence of a public nuisance and, on the materials placed, he considers that such unlawful obstruction or nuisance should be removed from any public place which may be lawfully used by the public, he shall act. Thus his judicial power shall, passing through the procedural barrel, fire upon the obstruction of nuisance, triggered by the jurisdictional facts. The Magistrate's responsibility under S. 133 Cr.P.C. is to order removal of such nuisance with a time to be fixed in the order. This is a public duty implicit in the public power to be exercised on behalf of the public and pursuant to a public proceeding. Failure to comply with the direction will be visited with a punishment contemplated by S. 188, I.P.C., Therefore, the Municipal Commissioner or other executive authority bound by the order under S.133 Cr.P.C. shall obey the direction because disobedience, if it causes obstruction or annoyance or injury to any persons lawfully pursuing their employment, shall be punished with simple imprisonment or fine as prescribed in the Section. The offense is aggravated if the

disobedience tends to cause danger to human health or safety. The imperative tone of S.133, Cr.P.C. read with the punitive temper of S. 188 I.P.C. makes the prohibitory act a mandatory duty.

Although these two Codes are of ancient vintage, the new social justice orientation imparted to them by the Constitution of India makes it a remedial weapon of versatile use. Social justice is due to the people and, therefore, the people must be able to trigger of the jurisdiction vested for their benefit in any public functionary like a magistrate under S. 133, Cr.P.C. In the exercise of such power, the judiciary must be informed by the broader principle of access to justice necessitated by the conditions of developing countries and obligated by Art. 38 of the Constitution.

Public nuisance, because of the pollutants being discharged by big factories to the detriment of the poorer sections, is a challenge to the social justice component of the rule of law. Likewise, the grievous failure of local authorities to provide the basic amenity of public conveniences drives the miserable slum-dwellers to ease in the streets, on the sly for a time, and openly thereafter, because under Nature's pressure, bashfulness becomes a luxury and dignity a difficult art. A responsible municipal council constituted for the precise purpose of preserving public health and providing better finances cannot run away from its principal duty by pleading financial inability. Decency and dignity are non-negotiable facets of human rights and are a first charge on local self-governing bodies. Similarly, providing drainage systems - not pompous and attractive, but in working condition and sufficient to meet the needs of the people - cannot be evaded if the municipality is to justify its existence. A bare study of the statutory provisions makes this position clear".

Environment and Fundamental Rights

Another important issue which has been debated in the past in academic circles as well as in judicial platform is whether the right to wholesome environment is included in the fundamental rights enshrined in the Constitution. Successive judicial pronouncements have extended the scope of Article 21 which guarantees life and personal liberty to include the concept of environment protection. The landmark judgment in wholesome environment as essential ingredient of right to life and personal liberty guaranteed in Article 21.

Similarly, the importance of the Protection of Environment was again emphasized by the Supreme Court of India in M.C. Mehta v. Union of India and others, AIR 1988, SC 1037 where the Court said :

> " Before proceeding to consider the facts of this case it is necessary to state a few words about the importance of and need for protecting our environment. Article 48-A of the Constitution provides that the State shall endeavour to protect and improve the environment and to safeguard the forests and wild life of the country. Article 51-A of the constitution imposes as one of the fundamental duties on every citizen the duty to protect and improve the natural environment including forests, lakes, rivers and wild life and to have compassion for living creatures. The proclamation adopted by the United Nations Conference on the Human Environment which took place at Stockholm from 5th to 16th June, 1972 and in which the Indian delegation led by the Prime Minister of India took a leading role.
>
> The proclamation also contained certain common convictions of the participant nations and made certain recommendations on development and environment. The common convictions stated include the conviction that the discharge of toxic substances or of other substances and the release of heat in such quantities or concentrations as to exceed the capacity of environment to render them harmless must be halted in order to ensure that serious or irreversible damage is not inflicted upon eco-systems, that States shall take all possible steps to prevent pollution of the seas so that hazards to human health, harm to living resources and marine life, damage to the amenities or interference with other legitimate uses of seas is avoided, that the environmental policies would enhance and not

> adversely affect the present and future development potential of development must be applied with identification, avoidance and control of environmental risks and the solution of environmental problems and for the common good of mankind, that States have the responsibility to ensure that activities of exploitation of their own resources within their jurisdiction are controlled and do not cause damage to the environment of other States or areas beyond the limit of national jurisdiction, that it will be essential in all cases to consider the systems of values prevailing in each country and the extent of the applicability of standards which are valid for the most advanced countries but which may be inappropriate and of unwarranted social cost and that man and his environment must be spared the effects of nuclear weapons and all other means of mass destruction. These are only some of the statements of principles proclaimed by the Stockholm Conference."

Rights against Private Corporations

Having accepted that right to clean environment and ecology as a fundamental right, the private corporate bodies have been excluding writ jurisdiction under Article 32 against them under the pretext that the fundamental rights are enforceable under the State alone. Therefore a private corporate body would not be subject to the writ jurisdiction of the High Court and supreme Court. This question has now finally been settled by Supreme Court in Indian Council for Enviro-Legal Action and Others v. Union of India and others (1996), 3 Supreme Court Cases 212 in which Court has held that :

> "The contention that the respondents being private corporate bodies and not 'State' within the meaning of Article 12, a writ petition under Article 32 would not lie against them, cannot be accepted. If the Supreme Court finds that the Government/ authorities concerned have not taken the action required of them by law and that their inaction is jeopardizing the right to life of the citizens of this country or of any section thereof, it is the duty of the Supreme Court to intervene. If it is found that the respondents are flouting the provisions of law and the directions and orders issued by

> the lawful authorities, the Court can certainly make appropriate directions to ensure compliance with law and lawful directions made thereunder. This is a social action litigation on behalf of the villagers whose right to life, is invaded and seriously infringed by the respondents as is established without obtaining the requisite permission and clearances and if the industry is continued to be run in blatant disregard of law to the detriment of life and liberty of the citizens living in the vicinity, the Supreme Court has power to intervene and protect the fundamental right to life and liberty of the citizens of this country."

Writs and Right to Information :

There has been tremendous increase in the Public interest litigation in matters relating to environment. The public interest groups have very often taken recourse to the writ jurisdiction of the higher courts under Article 32 and Article 226 of the Constitution. Writs of mandamus prohibition and certiorari have been often prayed for by the environmentalists either to issue a direction to the Government or prohibiting Government or a private party from causing any damage to the community or environment. Since the right to wholesome environment is included in the right to life and personal liberty under Article 21, courts have liberally admitted these writs in public interest. The rise in public interest litigation started in the 80's and continues till date. In order to equip themselves with technical data and expertise, the courts have appointed Commissioners for fact finding purposes. Another remarkable feature of environmental litigation is gathered evidence during the hearing itself and appropriate remedy is available to aggrieved party. The relief has further been extended to include public's rights to examine official records, the records of the private corporations or Government bodies. In this regard, Supreme Court judgment in Reliance Petrochemicals Ltd. V. Proprietor of Indian Express Newspaper Ltd., AIR 1975, SC-865 is relevant. The Court recognized the 'right to know' as emanating from the right to life : " We must remember that the people at large have a right to know in order to be able to take part in a participatory development in the industrial life and democracy. Right to know is a basic right (to) which citizens of a free country aspire (in the broadening horizon of the right to life) under Article 21 of our Constitution. That right has reached new dimensions and urgency. The right puts greater responsibility upon those who take upon the responsibility to inform. The strong link between Article 21 and the right to know is evident in environmental matters where secret government decisions may affect health, life and livelihood."

Similarly, Mumbai High Court in Bombay Environmental Action Group v. Pune Cantonment Board allowed the environmental group to examine building plans permission granted to private builders. The court held that :

> " Real democracy cannot be worked by men sitting at the top. It has to be worked from below by the people of every village and town. That sovereignty resides in and flows from the people. So said the Father of the Nation in whose name we swear. Therefore, 'Who will watch the watchman' is the vexed question before our democracy. For this people's participation at all levels is a must. Further as observed by the Supreme Court in R.L. and E. Kendra, Dehradun v. State of U.P., AIR 1985 SC 652, the question involving issues relating to environment and ecological balance, brings into shape focus the conflict between development and conservation and serves to emphasis the need for reconciling the two in larger interest of the people residing within the area and the country. Therefore it cannot be said that action groups are trying to meddle in the affairs of Cantonment Board or are claiming any extra-legal authority. On the other hand as observed by the Supreme Court in Neeraja Chaudhary Case it is high time that the Cantonment Board should start taking their assistance instead of looking at them askance and distrusting them. The vested interests will undoubtedly be against such social action groups. However, their help might check sabotage of development plans by unscrupulous persons and corruption at all levels. It may be noted at this stage that the petitioners are only claiming a right of inspection of the documents referred to above and nothing more."

This pronouncement have finally settled the issue that right to know can be effectively enforced in relation to environmental issues.

Chapter - 7

ISSUES AND RECOMMENDATIONS

The evolution of environmental law in India has witnessed a long journey in last thirty years. This journey has seen pro-environmental action from the non-Governmental organizations, a very active press and fully sensitized judiciary. If we look back there are certain issues which deserve deliberation. Some of them are discussed here.

1. ARE LAWS ADEQUATE ?

The first and foremost issue is whether the laws which have been enacted and their interpretation which have enacted and their interpretation which have emanated from the learned pronouncements of the superior Courts are adequate. From the vast literature available in this field, one would tend to agree that the laws on protection of environment are by and large serving the desired purpose. If at all there are any difficulties or discrepancies, the same are expected to get rectified or settled with the course of time. The Government, the legislature and judiciary are aware of these and have shown a hopeful concern about them.

2. IS ENFORCEMENT MACHINERY SUFFICIENT ?

The most fundamental issue in the whole debate about enforcement of these laws is the adequacy of the implementation aspect. Having had some of the best laws all over the world, it is the implementation part which has not been very encouraging. In such a large and developing economy, the primary concern naturally would be on production rather than on safety. This is a phenomenon which is not unique to Indian sub-continent. If we look back at the industrial revolution, the biggest polluters have been those very countries who are today the champions of pro-environmental legislation. With that background, the progress made by India in last 30 years is quite encouraging. However, one cannot over look the infrastructual inadequacy and Administrative bottlenecks. The financial position of the Pollution Control Boards in most of the States is dismal and the technical competence and man-power available with these Boards also presents the picture of neglect. In most of the Boards the Chairman and the Member Secretary are holding posts on ad-hoc basis and it may not be out of the context to mention that many of them may not be technically competent to hold these posts. The staff strength of these Boards is meagre as the creation of posts requires Administrative approval of the Governments at various levels. The position becomes worst when all of a sudden Government decides to declare an area industrially backward and allows various tax incentives to attract investment. Obviously, the capital flows but administrative arrangements to handle in implementation of laws are inadequate. This adversely affect the quality of the work and also results in delays in clearances therefore causing harassment to the investors. The Central Government and State Government shall have to have a close look in this regard and come up with more liberal and appropriate measures.

3. EFFECT ON DEVELOPMENTAL ACTIVITIES

Another issue which has been debated hotly all over the country is the effect of environmental laws on the development of tourism, fisheries and aqua culture. Since laws of environment are by the large uniformly applicable throughout the country, some of the States which are geographically smaller in area are hit most as far as their development activities are concerned. For example Kerala has a long coastal line and thick forests on its border with Tamil Nadu and Karnataka. The strict implementation of environmental laws both on the coast and in the western ghats leave very less area available for commercial and other developmental activities. Similar is the case of the island UTs of Andaman and Nicobar, Lakshadweep and other small UTs like Daman and Diu. The coastal belt in these areas is most ideal for development of tourism and aqua culture However, the Govt. of India under the Environmental (Protection) Act imposes restrictions on the development of coastal areas falling between 0-200 metres from the High Tide Line. The unilateral imposition of restrictions put extra strain on the already scarce land resource available with the local community. As such, the Agriculture land near the coast is getting converted for commercial purposes at a fast rate which is resulting in loss of another precious resource i.e., fertile land. It is rather unusual how such stringent measures have been adopted in India alone whereas in countries of Europe and America such norms do not exist and construction is allowed at a very bare distance from the High Tide Line. It is perhaps ideal to safeguard the coastal ecology and environment but the felt need of the local communities should also be given due consideration Unless there is a harmony between the requirement of law and the needs of people, the effective implementation of laws will always remain doubtful.

4. NEGLECT OF LOCAL REALITIES

The implementation of laws on environment have also resulted in conflicts with the local communities specially the tribal communities who primary depend upon forest produce for their livelihood and requirements of fuel. This issue is likely to become more complicated with increase in population and decline in the resources. In many of the States the Queries and Mines are owned by the Gram Panchayats and these are the only source of revenue and employment for the local people. A total banning of such activity is likely to do more harm to the cause of environment as the same will surely alienate the local community.

A classic case in this regard is that of Jaganath v/s. Union of India and Orissa Shrimp Farmers Association in which the Supreme Court in December, 1996 ordered demolition of all coastal aqua-farms within 500 metres of HTL. Agitation followed all along the coastal line and review petitions were filed by Department of Agriculture, Govt. of India. On reconsideration of the matter, the Supreme Court stayed its earlier order. However, the issue still remains unsettled. It was argued by Govt. of India that lakhs of people depend on this activity for their livelihood. In order to sort out this issue and regularise coastal aqua farming, National Aqua Culture Bill, 1997 was passed by Rajya Sabha. However, the bill is yet to be presented to the Lok Sabha.

In another case of P.N. Gandavarman Thirumulkpad v/s. Union of India and others. Supreme Court on 25.2.97 banned all non forest activity within the forest area without the prior approval of the Central Government. This resulted in closure of sawmills, plywood mills and mining of any mineral within the forest. Court ordered complete ban on felling of any kind of trees in the tropical evergreen forest of Thirap and Chalanglang of Arunachal Pradesh. All saw mills, Veneer and Plywood mills in Thirap and Chalanglang in Arunachal Pradesh and within a distance of 100 metres from its border in Assam were closed. Movement of cut trees and timber from any of the seven North-East states, any States of the country either by rail, road or water ways was banned. This harsh measure caused immense dissentment among the local communities because of loss of employment and income for the locals. Considering the politically sensitive nature of the North-Eastern States and the potential danger of foreign inspired insurgent activities, this judgment has given a handle to the anti-national elements to spre disaffection among the local people against the Central government. The Govt. of Ind and the State Governments moved the Supreme Court for review. Finally, Supreme Cou issued a detailed order on 15.1.1998 allowing disposal of timber with stringe conditions. It reiterated its view that licenses given to all wood based industries in fore areas shall stand suspended and State Govt. shall notify Industrial Estates for relocatin the wood based industry in consultation with the Ministry of Environment and Forest Govt. of India. Even though Supreme Court has relented from its earlier position, th adverse effects of relocating wood based industries to the Industrial Estates have not bee properly assessed. The tribal communities in North-East are deeply attached to their loca habitat and with the shift of industry they are surely going to loose their only source o livelihood. Government of India is aware of the adverse effect of these measures and i January, 1997 issued an ordinance establishing the National Environment Appellat Authority. This authority shall hear appeals with respect to restrictions of operations o industries under the Environment (Protection) Act, 1986. The ordinance excludes the Jurisdiction of the Civil Courts in the matter. It is not known whether the ordinance has been replaced by an Act or not? From the above discussion, it is clear that unless a pragmatic and concensual approach is adopted, the results of pro-environmental actions may turn out to be disastrous.

5. POOR REHABILITATION MECHANISM

The recent judgment of Supreme Court in Kanpur Tannery's Case and M.C. Mehta's Case in Delhi regarding relocation of industries have raised a controversy regarding rehabilitation of persons adversely affected by pro-environmental action. The Supreme Court's in Kanpur Tannery's Case appears indifferent to the issue of rehabilitation and the justice Kuldip Singh categorically stated that " the Court is conscious about the closure of Tanneries may bring unemployment, loss of revenue but life, health and ecology have greater importance to the people." In M. C. Mehta's case even though adequate provision has been made for rehabilitation of workers, yet, by allowing industries to relocate in far off places in States like Himachal or some district in Rajasthan, the miseries of the labour force to be shifted will increase many fold and make it almost impossible for them to shift alongwith the industry. Infact, this judgment has been used as a tool by the industries to get rid of a large section of labour which in Delhi is costlier than in peripheral areas. At the same time the estates so available from the industrial activities will give them undue financial advantage by allowing commercial use. It is also common knowledge that inspite of years of remedial measures taken by Government and the stringent directions of the Supreme Court, hundreds of cases of compensation in Bhopal Gas Tragedy remain unsettled. The rehabilitation mechanism is slow, full of apathy to the poor and reels in corruption. A broader look would have to be taken to make it more effective.

The social angle of the judiciary pronouncements and the adequacy of financial resources for rehabilitation have not been attended to in detail as yet. The provisions of Air Act, Water Act and other Acts are implemented in letter and spirit, there is a huge requirement of funds for upgradation of technology and also for skill-development of people who are displaced. A national debate on this issue is required and preferably a National Fund should be set up by the Govt. of India to take care of such issues. This fund could be maintained by levying some kind of taxes or a charge on every industry or activity which has affect on environment. A similar legislation in the Scandinavian countries is Carbon tax on the industries. It would be advisable if Government of India takes suitable action in this regard.

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Final Project Report

Energy Conservation Strategies For Upstream-Petroleum Sector

Submitted by
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ERS PROJECT REPORT

1997-98

NERGY CONSERVATION STRATEGIES FOR REAM-PETROLEUM SECTOR

By SUBODH KUMAR

Project Guide:
Shri R.K.Narang
TERI

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Date : 20th April, 1998
Place : New Delhi

(SUBODH KUMAR)
C.E.(Elect)
O.N.G.C.

PREFACE

With the rapidly growing demands for petroleum and petroleum products, India is faced with the prospects of substantial increase in imports, despite an increase in domestic production of crude oil and gas. If the country has to successfully implement developmental programmes that it has embarked upon, such imports would become necessary and that may lead to deep erosion in its already depleted foreign exchange reserves.

Introduction of more energy efficient production technologies; need for a long term policy for optimum management of growth in demands, substitution by different sources of energy, including renewable source of energy etc. have been indicated in the general context of ensuring sustained development in the country.

It is felt that the conservation efforts must be built in all operations so that the energy use is constantly monitored and conservation become a part of work culture.

The Upstream sector organizations, that are presently engaged in exploration and exploitation of oil and natural gas, which are vital sources of energy, are themselves users of energy in various forms. These organizations, it is imperative, must squarely shoulder the responsibilities of achieving conservation not only in the use of energy but also of conserving energy produced by them by avoiding wastage and misuse of oil and natural gas. Regardless of the scale of their own consumption, they have to create a work culture through education, training publicity and promotional efforts for energy conservation programmes at different levels.

Total process of petroleum upstream sector is an integrated team activity bringing together the work of experts and specialists of many different disciplines. A number of people work together in this industry whose flair is for fitting together the pieces of technical jigsaw. Their coordination and inclination to conservation can result in substantial savings of Energy.

Need is also felt to develop inhouse audit teams for identifying the grey areas for energy conservation as the outside auditing agencies in India are not well conversant

with the high technology process involved in the upstream sector. A questionnaire and a preliminary energy audit have been designed which are placed in appendices.

In order to ensure that energy is used efficiently certain strategies need to be evolved which should religiously & meticulously be followed by the oil industry. This report shall be an effort towards presenting feasible energy conservation ideas, projects and techniques for providing effective energy management in any industry particularly the upstream oil industry.

This report in addition to above is an effort to :-

i) Examine the entire range of activities in the areas of exploration, production and transportation of crude oil and natural gas with a view to identifying the scope of conservation and

ii) Make specific recommendations for effecting conservation and, wherever possible quantify the anticipated results of such recommendations.

Upstream sector organizations themselves use energy in various forms which are, primarily, electrical power, liquid petroleum products, and natural gas. It is necessary to take into account conservation of all kinds of energy while paying specific attention to conservation of hydrocarbons while examining various issues.

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TITLE OF THE PROJECT:-

ENERGY CONSERVATION STRATEGIES FOR UPSTREAM-PETROLEUM SECTOR

By SUBODH KUMAR

Rationale behind the study-

The Upstream Petroleum Sector is one of the few multi disciplinary trait in the world which has integrated expertise in the exploration and exploitation of hydrocarbons. Over the years Oil and Natural Gas Corporation and Oil India Limited have been successful in building up a vibrant oil ndustry in the country.

The energy sector, as we all know, has a very crucial role to play in the socioeconomic development of our country. A conscious policy aimed at the optimal development and utilization of energy resources in all its forms with due consideration to its impact on the eco system assumes aramount importance in this context.

Major energy resources being used in the upstream sector are electric power and petroleum roducts. The demand for electric power has been growing at a faster pace, outstripping the growth n availability, with the result that we have been facing power shortages, in different parts of the ountry. Similarly the level of self-sufficiency or crude oil in India rose from 0.5 % in 1960-61 to 0 % in 1984-85 and declined thereafter due to the fact that consumption rose more sharply than ncrease in production. In 1993-94 the level of self sufficiency in Oil remained only 41%.

While striving to make the country self reliant, most vital source of energy, Oil and Natural ias, the producing companies themselves are using a huge amount of energy for their operations.

The energy bill of ONGC & OIL during 1994-95 has been of the order of over Rs 450 rores. An overall reduction of 10% envisaged during the forthcoming five years may provide ubstantial savings in the upstream petroleum sector. Therefore a systematic approach is to be dopted to use energy efficiently and intelligently. The efficient use of energy would help in xtending the life of the most scarce resource usually called the Black Gold.

The exploration and production of oil and gas requires a variety of heavy drilling quipments to be moved to various remote locations and a fleet of Offshore Supply Vessels's, chop-ers and trailers are required to be maintained for both offshore and onshore. Demand of liquid fuels by the logistics departments is reasonably high. This aspect need to be borne in mind in order to optimally plan the use of vehicles.

With the changing scenario of Oil & Natural Gas findings, the utilization of Natural gas so as to conserve liquid fuel is also important.

Total process of petroleum upstream sector is an integrated team activity bringing together the work of experts and specialists of many different disciplines. A number of people work together in this industry whose flair is for fitting together the pieces of technical jigsaw. Their coordination and inclination to conservation can result in substantial savings of Energy.

Optimum utilization of energy and scarce fuel oils in all the activities is therefore vital. Due importance is to be given for identifying grey areas for energy conservation and implementation of energy conservation programmes.

Need is also felt to develop inhouse audit teams for identifying the grey areas for energy conservation as the outside auditing agencies in India are not well conversant with the high technology process involved in the upstream sector.

In order to ensure that energy is used efficiently certain strategies need to be evolved which should religiously & meticulously be followed by the oil industry. This report shall be an effort towards presenting feasible energy conservation ideas, projects and techniques for providing effective energy management in any industry particularly the upstream oil industry.

Objective of the Study

- To define the corporate objective as regards to conser vation of energy for the upstream sector.
- To lay down the guidelines for working managers to initiate and implement the energy management programme.
- To suggest various alternative possible known methods for energy conservation.
- To provide guidelines for organising energy management groups in each industry.
- To develop a common information system for energy management for all the upstream industries.
- To suggest a workable mechanism for adoption of energy conservation in Oil Industry.
- To review the present system of energy conservation for various activities like drilling production etc., with a view to remove deficiencies of the present system.
- To explore the potential of Oil substitution by Natural Gas.
- To provide necessary guidelines for conducting energy audits through inhouse teams.

Data analysis and Methodology.

- Study of the highly specialized nature of activities of ONGC and OIL practiced for exploration and production of Oil.
- Study and Analyze the existing energy conservation practices in ONGC and OIL.
- Study of the widely dispersed activities involved in exploration, drilling operation/ production in oil fields and find out possible energy saving opportunities.
- Study of organizational setup and decision making process in ONGC and OIL with reference to energy management.
- Collection of Data regarding consumption of energy in various activities for production of petroleum products.
- Perusal of data files and other related documents and copies of statistical data and analysis relating to consumption of energy.
- Interactions/discussions with a large number of officials, primarily those of the drilling and production Departments of these organizations.
- The data so collected will be analyzed from conservation point for different business groups/ regions / departments and projects within the industry.
- Future plans/ requirements of operations will be analyzed with a view to find future energy demand.
- Making of interim report and seek feedback from ONGC and OIL Officers involved with energy conservation.

Expected contribution-

- This study will help officials , engineers and techno crats, in formulating strategy for their respective departments for reducing the consumption of energy.
- Shall help the upstream sector industries to strengthen their human resource used for Energy Management.
- Certain measures will be recommended in the report by which conservation of energy can be achieved in upstream oil industry.
- Avoiding delays in the finalization of new projects / installations by using the ready alternatives available in this report shall reduce uncertainty and absorption of indeterminate raising costs of the projects.
- Some companies may take advantage of the experience of other companies on energy consrvation techniques used by them for similar operations.

- Will save precious manhours involved in the time consuming process of calculating economic analysis and life cycle costing in respect of known methods of energy conservation through technologies suggested in this report.
- Oil industry shall be able to develop their own inhouse Energy audit teams which will initiate an inbuilt energy management circle within the industry.

11.0 WIND POWER

11.1 Wind Energy by its very nature is available free, is not subject to any price escalation, will not be exhausted and, of course, is environment friendly. The production and use of wind energy neither pollute the atmosphere in any way nor it leads to global warming.

11.2 The upstream petroleum companies use electrical energy for production installation and other purposes mainly from the respective state electricity boards. Their demand is likely to increase in the coming years because of secondary recovery of oil.

11.3 Judging from the power scenario, the future is not certain. Electricity boards may not be able to release such quantum of power in future easily. Keeping in view, to go for own power generation, especially when cheap power, in the form of wind energy is available, is a good option.

11.4 Keeping pace with the changes taking place in the power sector, wind energy is proving to be a very much viable option. A bunch of incentives viz sales tax exemption/ deferment, income tax incentives (Details at annex-I) are being offered by central and state governments. State electricity boards are offering 'wheeling of power option' at a 2% nominal wheeling charge.

11.5 The technology of setting up wind farms is well established in India now. The present capacity of wind farms is around 700 MW in INDIA. Nodal agencies for wind farm generation in various states is given at annex-2. List of manufacturers of wind turbines in India is given at annexure-3. Costing cash flow and Net Present Value statements for 5 MW wind power generating farm are placed at annexure 4-5-6.

11.6 Though some incentives like sales tax benefits offered are valid only upto the specified dates by the state & central governments. Keeping in view the worst scenario the study shows that project is viable and its net present value is positive.

11.7 Keeping in view the vast potential of wind energy and its cost effectiveness, it is proposed for upstream companies to go for this project.

Role Of Energy Conservation

1.1 Introduction

1.1.1 Development without Energy is impossible and with increase in the level of development the consumption of Energy also increases. The share of commercial energy in the total energy portfolio varies directly with the level of development as a result the energy demand of developing countries is continuously increasing.

1.1.2 As compared to the per capita consumption of primary energy, India consumes only 1/10 th energy as compared to most developed countries. To provide enough energy for the growing demands of its large population is the key issue and has to be a basic ingredient of the country's economic policy and to ensure the availability of energy at appropriate cost. is therefore the most important factor.

1.1.3 Alternate sources of energy need to be harnessed for sustainable development as the reserves of fossil fuels like coal, oil and natural gas are depleting very fast. Petroleum (oil and natural gas) is the most versatile of the fossil fuels and is most sought after energy resource. The scenario for per capita utilization of energy and share of different energy uses in most part of the world is shown in plate 1 and 2.

1.2 Petroleum Energy Resource

1.2.1 Although the share of oil in the total energy portfolio, in the Asia pacific region, is 38 percent, the fact is that it has grown very fast in just 25 years. Dependence on this fossil energy resource is still increasing.

1.2.2 As per various estimates India will need about 100 million tones of oil by the year 2000. Even if we produce 50 million tones of oil that year, this will still leave a gap of about 50 million tones to be filled in by imports or through Inter-fuel substitution.

1.2.3 The third world population demands better standard of living and the demand for energy will rise substantially resulting in energy crises and its price rise. Based on the BP statistical review the reserves of oil is presently the most vulnerable (world R/P ratio for oil is 42.2). For India the situation is indeed very critical as in just about the next 16-17 years, we would have depleted our present oil-yielding fields.

1.2.4 Besides the cost component , the very availability of energy in the form of oil may be in doubt. New discoveries of energy may provide temporarily relief , but as world prices rise, toil is unlikely to be cheap sources for very long. The energy issue therefore is likely to become more and more gruesome as the time passes and a determined and pragmatic energy policy is the only solution to deal with this problem.

1.2.5 Gas being nearest to oil in its versatility and has proved to be a major energy resource, the world over. In the inter-fuel substitution scenario, natural gas is certainly the best option to replace oil in the Indian context. Today it can be predicted with high probability that proven reserves of natural gas are at least equal to that of oil, if not surpassing it. The gas can be put to variety of use-power generation, fuel for heating and transport, feed-stock for fertilizer, methanol and petrochemicals etc. India has tapped over 1900 million cu.m/day of natural gas in 1996 from its existing and developed fields with an R/P ratio of over 33. (equivalent to about 33 years of stock at present rate of production)

1.2.6 Judicious and efficient use of fossil fuels can help the country to continue with its development programmes without much dependence on imports. Energy Conservation is therefore very significant in todays context.

1.3 Energy Conservation in Petroleum Industry

1.3.1 In India,commercial energy - namely coal, oil and natural gas provides - the basic requirements of energy in urban and industrial sectors. Oil & Gas is used in commercial sector as feed-stock, as fuel for heating, and as a resource for power generation.

1.3.2 To ensure efficient use of energy certain measures must be encouraged while evaluating the need of energy application.

a) Energy usage, method and per unit consumption may be challenged, including the type of process used and its productiveness compared to alternate process.

b) While designing plant and buildings energy requirements for construction and operation should be targeted. Various plant units and Process should be integrated to gain maximum energy efficiency.

c) Measurement and process integration are key parameters for saving energy. If possible, at each stage of pressure or temperature changes best use of energy should be made as the energy is mostly lost in the form of heat to outside environment. Such heat losses therefore must be recovered and used to provide useful work.

d) 'Energy Audits' help in identifying key energy consumption areas. In petroleum industry ike any other industry, the major energy wastage takes place through:-

- Heat loss while products are cooled using cooling water or air.
- Flue gas leaving gas turbines or furnace.
- Energy losses during transportation of materials.
- Inefficient electrical equipments.
- Low electrical power factor.
- Pressure drop without any productive use.
- Leakages of fuels, heat, steam, and other useful chemicals.

1.4 Energy Audits ?

1.4.1 The Energy Audit study provides a systematic and powerful approach to the process of energy conservation. Measuring energy consumption is an essential aspect of using energy efficiently and hence is the first objective of an Energy Audit. In an energy audit we first study the existing process plant and its systems, to assess and identify the areas where improvements in energy efficiency could be made and then we try to optimize energy consumption per unit of product.

1.4.2 Optimum energy consumption norms / targets can be fixed with a high degree of objectivity for monitoring, controlling and modifying the operations. There are several areas of obvious wastage which go unnoticed because the operating personnel have got used to seeing them. Experienced observes can quickly identify such areas objectively. 'Preliminary' or 'walk through' energy audit thus aims at carrying on sector-wise identification and study of major energy consumers such has Fired Heaters, Boilers, Heat Exchangers, Distillation Columns, Pumps and Compressors, Steam and Cooling Water Systems, Power Generation etc. The 'quick or walk through' audit can generally be carried out in a period of 3 to 7 days to suggest certain 'obvious' energy conservation (ENCON) measures and also highlight areas of special concern for the comprehensive Energy Audit. The comprehensive Energy Audit is preferably carried out by the plant personnel with support from experienced Energy Auditors specialized in various 'ENCON' techniques. Detailed Energy Audit will

- Identify and quantify major energy users, abnormally high energy users, inefficient energy users, energy-use norms and the possibilities on 'ENCON' which can be implemented to bring the plant closer to energy efficient levels and

- Bottlenecks in operation which hinder Energy Efficient performance.

1.4.3 The Energy Audit should primarily help in more energy efficient performance of the plant. It is therefore essential that the savings in energy costs as a result of 'ENCON' measures implemented as a consequence of Energy Audit should be 'real'. This would help save energy, reduce cost and make plant more energy efficient, thus helping energy resource last longer.

1.5 Energy Conservation and Environment

It is now a well established fact that carbon dioxide produced as a result of burning of fossil fuels leads to global warming. C02 is proved to be major constituent of the 'Greenhouse Gas'. The global injection of carbon due to burning of fossil fuels (coal, oil & natural gas) is about 5 trillion Kgs of carbon/yr and India contributes about 2.8 percent i.e. .14 trillion kgs/yr of carbon in this. While the developing nations are continuing to increase their share of fossil fuels for industrialization; their people, especially in rural areas, continue to depend on biomass, specially firewood for their basic needs of energy. Increased emission of C02 coupled with deforestation is therefore harming our environment and there is need to conserve energy not only from the cost-savings view point but from an even wider objective of saving our environment.

1.5.2 Increased industrialization is bound to take place for the progress of our country. Energy efficient and conscious approach towards cleaner environment can only lead to sustainable development which a key to success.

1.6.0 Strategy

1.6.1 Best strategy for Energy Conservation is therefore to use those approaches, methods, and technologies where 'Energy', 'Efficiency' and 'Environment' are all found viable and sustainable.

1.6.2 Economically viable, socially acceptable and sustainable energy efficiency improvements to be stimulated.

1.6.3 Renewable energy technologies and devices should be promoted where viable and sustainable.

1.6.4 Like many other developing nations, India should modernize over wasteful and polluting technologies to environmentally and energy efficient technologies. In addition these technologies must also provide tangible cost savings to obtain wide-spread use by the industry.

Organisations And Activities Of The Upstream Petroleum Sector

2.0 Agencies Involved In Exploration, Exploitation And Transportation Of Oil And Gas.

2.1 The upstream petroleum sector is engaged in the exploration and exploitation of Oil and Natural Gas. Oil India Limited (OIL), Oil & Natural Gas Corporation (ONGC) and Gas Authority of India Limited (GAIL) are the main companies employed in this sector. Several other private companies like ESSAR (India) and Bhilwara etc are also engaged in the business of drilling oil wells but are drilling for ONGC or OIL.

2.2 The Oil & Natural Gas Corporation Ltd. (ONGCL) and the Oil India Limited (OIL) are the two organization engaged in exploration and exploitation of Oil and Natural Gas in India quantities.These organizations also process crude oil and natural gas and fractionate gas to extract various fractions. The Gas Authority of India Limited (GAIL) is the agency for transportation of gas which it takes from ONGC and OIL, and distributes the same to a number of distributors. GAIL also process / fractionate gas and produces a few value-added products like LPG.

2.3 All the three organizations already have Energy Conservation as one of their principal corporate objective. These organisations achieve such Energy Conservation through efficient use of energy, avoiding wastage, leakages and losses etc.; and, whereever possible, liquid hydrocarbons are substituted by other sources of energy.

2.4 ONGC carry out exploration for hydrocarbons in a number of sedimentary basins. Assam, Assam-Arakan Basins (inclusive of Nagaland, Mizoram and Tripura), Cambay Basin (Gujarat); Krishna-Godavari and Cauvery basins (Tamil Nadu and Andhara Pradesh); Bengal basin (West Bengal); Ganga Valley (U.P. and Bihar); Himalayan Foothills (Himachal Pradesh and Jammu Kashmir) and Rajasthan are the onland basins whereas ONGC is exploring along the entire western coast from Kutch to Kerala - Konkan and on the eastern coast its offshore activities are in Tamil Nadu, Andhra Pradesh and West Bengal.

2.5 The ONGC's oil and gas producing areas are (a) Onland - in Assam, Gujarat, Tamil Nadu and Andhra Pradesh, and (b) Offshore - it produces oil and gas from Bombay Offshore Basin and Krishna - Godavari and Cauvery Basins. Some gas reserves have have also been established by ONGC in Rajasthan and in Tripura but these resources are still not being fully exploited.

2.6 The OIL has been exploring and producing oil and gas mainly in Assam and Arunachal Pradesh. It has also carried out some exploration in Mahanadi Basin (both onland and offshore) and in Rajasthan. Some exploratory efforts were made by OIL in the offshore areas of Andaman island. They have established gas reserves in Rajasthan which are awaiting development and exploitation.

7 The GAIL was set up for transportation, processing and distribution of gas. It has
nstructed and now operating the HBJ pipeline and has been supplying Western Offshore gas
a number of fertilizer and power plants, and other industrial consumers along the pipeline
ute. Compressor stations at Hazira, Jhabua, Bijaipur and Auriya are functioning which in-
ease the pressure of the gas in the pipeline. GAIL is involved in linking the HBJ pipeline, to
her points for supply of gas to power plants. GAIL is also engaged in gas fractionation , ex-
ction of LPG and producing petrochemical, before supplying the lean gas to the consumers.
also takesup gas processing, transportation and distribution infrastructure in other regions of
dia. Project of Development of transport vehicles on Compressed Natural Gas fuel is also
ing taken up by GAIL.

Scope Of Conservation

3.0 ' Scope Of Conservation in Activities Of The Upstream Sector'

ONGC, OIL and GAIL are doing almost similar activities and scope of conservation exists in all the areas of operation of these companies. The activities undertaken are as follows:

3.1 Oil Exploration Activities

ONGC and OIL both have to remain engaged in exploration activities for establishing reserves of oil and natural gas. For exploration, they carry out a number of surveys and exploratory drilling.

A. Surveys

3.1.1 The surveys conducted for petroleum exploration include geological, geo-chemical, geophysical, gravi-magnetic and seismic surveys. In these surveys the use of energy, particularly of petroleum products, is limited to fuel for transport vehicles which use either motor gasoline or diesel oil (HSD). The scope of conservation is, therefore, confined to efficient use of fuels in vehicles and this appears achievable through regular maintenance of vehicles and proper driving practices besides keeping an accurate account of consumption. The methods of conservation here would therefore, be the same that would apply to general transport vehicles anywhere else. Though the scope of conservation per vehicle is very small, the total consumption, considering the large fleet, can be significant. Amongst these surveys the seismic surveys employ a large number of vehicles which include passenger vehicles, equipment trucks, drilling units in onland areas and seismic survey vessels / ships in offshore. It may be noted that the surveys are carried out by the two organizations both through departmental equipment and survey parties as well as through contract services. Again the survey parties work in different kind of geographical terrains; in various modes of detailing - i.e. regional surveys,2D and 3D seismic surveys. Inspite of the fact that the difference in the type of equipment or technique employed, it is felt that it should still be possible to set up standards and norms for different type of vehicles for their fuel consumption, as these are repeatedly used.

3.1.2 By proper planning of surveys considerable amount of fuel wastage can be avoided. Use of fuel efficient vehicles and proper maintenance of survey vehicles also lead to conservation of POL.

3.1.3 In Offshore, ONGC has been monitoring consumption of fuels over last eight years in their seismic vessels and has been able to effect considerable savings.

3.1.4 It can be concluded that by use of fuel efficient vehicles, proper planning of operations, and regular monitoring of consumption worthwhile savings can be effected in the consumption of transport fuel in the seismic and offshore survey field parties.

B. Drilling and Workover Operations

.5 Drilling is carried out after selection of sites chosen on the results of geoscientific veys. The rigs that are deployed for carrying out rotary drilling vary in size and capacity as ll as in the energy inputs. The drilling operations use diesel as fuel for the rigs. Now a days ctric driven rigs are in operation yet, due to on site power generation through diesel electric nerators, the main source of energy remains diesel.

IGC and OIL together have a fleet of over 200 rigs which include onshore rigs, offshore rigs d work over rigs.

.6 Main equipments on drilling or workover rigs comprise of Diesel engines, Electric nerators, AC or DC motors, ACSCR control system, motor control centers, mud pumps, aw works and a number of smaller capacity auxiliary pumps and equipments. These systems quipment need to be studied separately from the energy conservation angle and this alone can ad to reduction in energy consumption at the rigs. In ONGC offshore rigs, the waste heat is ing recovered to generate potable water through waste-heat water-makers. By using such aste-heat.

1.7 Presently, ONGC and OIL are regularly monitoring the energy consumption pattern, rticularly of POL consumption, at drilling and workover rigs. The Drilling Consumption dex (DCI), has been defined as specific energy consumed in terms of equivalent electrical its for drilling of one meter of well depth. Likewise, OIL is also monitoring consumption data r their Drilling activities.

1.8 Discussions with OIL and ONGC engineers have revealed that certain measures have eady been adopted by them which have indicated the possibility of reduction in consumption it a number of other measures, considered necessary by them are yet to be fully taken though ese have already been initiated. These are ;

Controlled running of rig engines, without sacrificing the operational requirements.

Reduction in use of diesel for mixing in the mud, particularly for sub-hydrostatic rmations during the drilling operations. R&D efforts have been and are still being made for olving more cost effective alternatives and additives for preparation of drilling mud instead of ude oil and diesel oil. Some of the formulations developed as a result of the R&D indicate to t only possible savings in oil but also with improved mud quality. Apart from its higher cost, d difficult availability, Institute of drilling technology (IDT) noted that diesel, at the best, ovides poor lubrication and tends to lose its lubricating properties as soon as it forms a tight nulsion with water in presence of mud additives like lignosulphonate. IDT, Dehradun has veloped an additive called IDT Lube which can be used, along with linseed oil, in the high ecific gravity mud. Use of drilling detergents can, however, be limited to the low specific avity mud. In conclusion, it is found that base on effective concentration and the lubricity nction it is not only possible but also technically advantageous and cheaper to use these ternatives in place of diesel oil. The trials carried out by ONGC have given encouraging sults. Nevertheless, more efforts and more wide spread use of non-hydrocarbon additives, in eparation of drilling fluid, are warranted.

) It has been found that conservation would be necessary not merely of fuel oil but also for bricating oils, Efforts to achieve this have indicated clear possibilities. In the routine transmission systems it appears possible to reuse lube oil to certain extent instead of changing to new lubricating oil. Change of lubricating oils on the basis of actual analysis instead of the unusually derived norms on the basis of Engine Running Hours is considered desirable. Certain lubricating oil kits have been designed to determine actual condition of oil which leads to effective saving of lubricating oil without endangering the engines in any way. The order of saving estimated on account of this change in practice can be as high as 40%. However, it is necessary that engines are also properly tuned up periodically for greater efficiency.

iv) Power factor improvement on ACSCR Rigs:
It is observed that p.f. on ACSCR rigs are very low. This is basically due to using mud pumps at low RPM/or with a higher liner size. Low RPM running of motors lead to low power factor and at times p.f. goes as low as 0.5. The lower powerfactor demands more KVA. so to use full power of engine either we can have large capacity alternators or we can improve the p.f. of the system by adding powerfactor controll system for ACSCR Rigs. How ever conservation can only be achieved if by improving p.f. of the ACSCR Rigs we are able to reduce the number of engines running on a particular rig.

v) Converting Diesel engines to dual Fuel Engines, where ever the rigs are operating near vicinity of the Oil/ Gas Fields for development purposes. This can definitely be thought of in the work over rigs.

vi) Installation of flowmeters will be very helpful to monitor the consumption.

vii) Waste heat recovery based water makers at offshore rigs: In offshore drilling Rigs waste heat recovery methods are being used to generate potable water for requirements of drilling operations. Similarly waste heat in the exhaust gases of D.G. sets can also be used for enhancing the recovery of waste heat.

Apart from these major areas, the individual equipment on drilling rigs requires to be looked into from energy conservation angle.

3.1.9 Workover Rigs are low capacity rigs similar to the deep drilling rigs and similar steps, as identified for deep drilling rigs, can also be applied to the workover rigs.

C. Development of Oilfields

3.1.10. Once oil/ gas has been discovered it becomes necessary to delineate the structure and assess the production potential. For doing so, delineation drilling or assessment drilling is carried out. Having defined the boundaries of oil, gas, and water, schemes of development are prepared and required number of production wells, to produce the desired quantity of oil and gas are drilled. From the conservation point of view, however only drilling operations are relevant in this activity. Developmental drilling is not different from any other drilling from this consideration and therefore, the conservation steps considered above, under exploration and delineation are applicable here also.

3.1.13 The consumption of energy, both in the form of electricity and POL, in the drilling operations is already showing a downward trend due to certain measures taken by the two organizations. The studies have, however, indicated that there is further scope of conservation if provements are effected in a number of equipments, such as ACSCR electrical control stem to achieve higher power factor; soft starters are used and a few other steps of this type taken. Scope also exists in some of the rigs for improvement in their lighting system. edless to say that the oil spillage at the storage tanks and at the engines must be prevented. In dition to conservation of the precious POL such a step will also ensure a safe and cleaner drill e.

2 Production Of Oil And Natural Gas

Onland Production Installations

2.1. The oil and gas from different wells is to be brought to a central point or first to a mber of collecting stations from which again it is brought to the central point for separation, cessing and treatment. For this, Group Gathering Stations (GGS) / Oil Collecting stations CS), Central tank farm (CTF), Compressor stations, etc. are required. These installations ndle the crude oil and gas starting from the well head and right upto the custody of transfer int (which may be refinery or a terminal from which oil is exported out of the area through elines/ tankers). The main units attracting energy conservation measures are therefore, well ads, storage tanks, vessels, crude and gas handling equipment, pipeline network and manilds, gas separators, stabilizer units, heater treaters, demulsification plants, effluent treatment ants, LPG Plants etc. Unless proper care is taken the losses can run very high in these operans.

2.2 Component wise examination has shown that the nature of the losses/ waste of crude oil d gas occurs at several places:

) **Crude Oil:**

) at well head :

i) Losses due to scraping / swabbing operations
ii) Losses due to spillage in the cellar pit while operating / testing oil/Gas flow lines
iii)Losses during sucker rod pumps operations

) at OCS/GGS

i) Losses at emulsion treater or Gas / Oil Separator, stabilizer vessels, separators Heaters. etc.
ii) Oil loss with formation water.
iii) Storage tanks during cleaning operations.
iv) Losses in flow lines.
v) Spillage losses during loading/unloading operations.
vi) Spillage during pumping operations
vii) Dewaxing operation of storage tanks and lines.
viii)Vapour losses from tanks.
ix) Leakages from lines/valves.

(c) At tank Farms
i) Vapour losses - cleaning/ changing over etc.

(d) At crude treatment plant / crude oil conditioning plant.

i) Losses at treater/ Vessels/Emulsion Treaters.
ii) Losses in flow lines.
iii) Losses from storage tanks during cleaning dewaxing operation.
iv) At the and pumping units during crude treatment with flow improver/ dozing units.
(e) At main pump station.
i) Spillage during pumping operations
ii) Leakages from main trunk lines and valves.

(B) Gas

(a) at well site
i) Flaring during testing operation/escape from loose points of valves/flow lines.
ii) Gas shots - losses - gas lift operations.

(b) at GCS/OCS
i) During separation of oil/gas/ water processing.
ii) Escape from flow lines/ compressor components.
iii) Gas flaring of associated gas.

(c) at Gas Injection stations/ Compressor stations
i) Losses from gas lines/ leaky valve.
ii) Escape from flow lines/compressor components

(d) At Gas Offtake points
i) Escape from leaky valves.

From the above it would appear that the nature of crude oil / natural gas losses have to be taken care of. Most of this loss can be prevented by vigilance and proper maintenance. In case of flaring of associated gas due to absence of consumers some special measures have to be taken. This is being dealt in this report separately.

3.2.3. Some of the other measures that have already been taken / are being taken to cope up with the losses indicated above are:

(a) Vapour losses from tanks (case to case basis)
i) installation of pressure - vacuum valves on tank top.
ii) installation of tank vapour recovery plants.
iii) installation of floating roof tanks (wherever possible)

(b) Oil loss with formation water:
i) installation of effluent treatment / water clarification plants.

(c) Installation of duel fuel engines

Such engines when installed at sucker-rod pumping/other operations ables use of gas otherwise flared. However, more important steps for major saving in flared as, as stated above, are discussed elsewhere in the report. (Chapter-6).

2.4 Some of the other operations, during the production of crude oil and gas which quire further attention are :

i) Sucker rod pump on the well

These sucker rod pumps are basically variable load type and ONGC is ilizing soft starters with energy saver in place of conventional starters, and there is the scope about 5 to 20% energy saving savings depending upon size and load requirements. These pe of starters are being installed on different installations in ONGC.

ii) Substitution of liquid fuel by low pressure Natural Gas which gets flared f, through installation of Dual Fuel / Gas Engines.

At all the production installations, there are diesel generating sets working as standby wer supply. All these can be converted to dual fuel engines thereby substituting 50 to 70 % esel by Natural Gas.

Similarly all other new installations may be provided with only gas engines / Dual Fuel gines depending upon the site requirements.

iii) Screw pumps for crude oil lifting have successfully run in ONGC at hsana in WRBC which are 10 to 15 % more efficient than conventional pumps.

iv) Variable Frequency Drives (VFD)

This is basically a starter which controls the energy input to the drive (Motor pumps s) as per requirement of the load on the pump and also saves energy lost in the throttling ves in the delivery and suction lines, ONGC has taken up the project of installing about 19 . VFD's on crude handling pump stations. These drives are expected to save around 20000 ctrical units per annum per drive. These drives will find wide applications on large motor np sets with variable loads.

v) Use of Solar Power for Cathodic protection system

For corrosion prevention of oil and gas pipeline. ONGC has started using solar power ed cathodic protection system on our pipelines in place of electrical power based system. has been already making noteworthy use of solar energy in such operations as well as other rces of energy.

5 The two organizations ONGC and OIL have been monitoring energy consump- for these installations on plant-wise, region wise basis. Energy Index is defined as total rgy consumed in all the activities of the organisation divided by total production of oil and quivalent of gas (O&OEG).

Offshore Production and Process Platforms

3.2.6 Nearly all the production/processing platforms in offshore (ONGC) mostly use natural gas as a fuel for different operations; 90% of the energy consumption of Bombay offshore region is met by natural gas as primary source for energy for generating electricity with gas turbines. Further, the waste heat of the gas turbines is being used for generation of process steam and potable water for living quarters on these platforms (as in case of offshore drilling rigs mentioned earlier).

III LPG and other processing plants (Onshore)

3.2.7 ONGC, OIL and GAIL have LPG plants in their gas processing units. ONGC has these plants at Uran and Hazira (Offshore gas), Ankleshwar (onland gas),OIL has one plant at Duliajan and GAIL has at Vijaipur. These plants merit greater attention from energy conservation angle.

3.2.8 ONGC is having 2 numbers 40 MW gas turbine generator plants at Uran and Hazira which are generating power for its own requirement the excess power is being exported to MSEB and CSEB (it was noted that these Electricity Boards are not paying for this creating a disincentive). OIL also has been utilizing the waste heat of the exhaust of the 14.45 MW gas turbine set at their Duliajan power station and producing about 1.21 million units of electricity through this waste heat recovery plant. Of this about 1.18 million units are supplied to ASEB.

The energy recovered from the expander at Vijaipur is utilized to recompress the gas. GAIL is already implementing the hot water system utilizing the exhaust flue gases from lean gas compressor turbine in LPG plant.

In propane recovery plant, waste heat from propylene refrigeration compressor will be utilized to generate steam and the steam will be consumed in the process units or power will be generated.

3.2.9 Both ONGC and OIL have started making use of solar energy displacing other source of energy input at several places including the need for lighting.

3.3 Logistics

3.3.1 The operations of both the organizations are carried out in greatly varying kinds of terrains ranging from plains to hilly to marshy areas and deserts onland and from shallow to deep waters in offshore. The operating equipments men and materials have to be transported to all these areas for carrying out the operations. To meet these tough logistic requirements round the clock and throughout the year, a very efficient land, air and marine logistic support is provided in both the organizations. The transport equipments ranges from passenger vehicles (buses, jeeps, cars etc) to medium and heavy duty trucks and trailers and tankers etc., material handling equipments such as cranes, crawler, pipe layers, bulldozers, loaders etc. for land, helicopter for air and supply vessels for offshore operations. There is a considerable scope of energy conservation on these activities. The basic energy inputs to these logistic equipments are petroleum products in shape of motor gasoline, diesel, aviation turbine fuel, lubricating oil greases etc.

3.2 Regular monitoring of fuel consumption is being done by ONGC on the offshore pply vessels operating for material supply to operating rigs and platforms in offshore area. ergy index monitored is KWH per ton of cargo.

3.3 As stated before both the organizations have introduced more fuel efficient hicles for passenger transport and for transportation of materials. There is a need to introduce ore of such fuel efficient vehicles, in replacement of old vehicles.

3.4 No doubt proper maintenance and upkeep of vehicles will lead to a definite vings in POL used on equipments. Use of fuel and lubricant additives can also lead to energy nservation in terms of POL. Proper planning in done for deployment to reduce empty runs of hicles to reduce POL consumption. OIL has been following the practice of deploying which tted special oil field trucks in their fields which are capable of loading/off loading of heavy uipment weighing upto 35 tons anywhere without the help of cranes thus resulting in fuel ving to a great extent due to reduce deployment of vehicles/cranes. To accomplish this, all the g equipment have been mounted on unitized special self loading type of skids. Similar actice if followed in ONGC, will accrue large saving of fuel.

election of proper types of vehicles material handling equipment for a particular type of job sumes great importance towards energy conservation. Battery operated fork-lift-trucks have en found to be effective replacement of diesel fuel machines.

4 Utilities

4.1 This is another important area which provides utility services to the staff and ecutives in these organizations by providing the services in offices, residential colonies, drill tes and field party camp colonies, Institutes, Hospitals; Hostels and other work centers. These rvices include providing lighting, lifts air conditioning, captive power generation, hot water quirement, domestic fuel etc. The input of energy to these utilities are in the from of ectricity, diesel, natural gas etc. In case of ONGC the need of electricity is met mostly from e power supplies taken from the State Electricity Boards in the respective areas. In case of IL total power requirements are met by internal generation by gas turbines and even surplus wer is being sold to state grid. Variety of equipments are being used, such as diesel nerating sets, gas turbine sets, motors, control centers, air conditioning compressors, lift uipment, pumps etc for providing these utility services.

.4.2 Most of equipments indicated above are in use in other areas of main operations both these organization and methods of energy conservation will apply here in similar anner as detailed elsewhere in the report.

.4.3 For general lighting requirements a number of proven equipments and technologies are now available in the market which when used should lead to energy conservation. lectronic chokes, sodium and other low wattage lamps, electronic regulators etc are few to ention. These are required to be included at the design stage in the installations and when cost fficient replaced in the old installations.

.4.4 Considerable amount of hot water and distilled water is required for these utility rvices. Solar thermal heating is systems are the proven and economic approach for hot water d distilled water requirements. These are widely used in ONGC and about one lakh liter per day capacity hot water solar system have been installed in ONGC for hot water requirements of Hospitals, hostels, drill site camps, canteens, guest houses etc. and about 125 nos of distillation units are installed for fulfilling the partial requirement of distilled water. OIL has also taken initiative on utilization of solar energy and have installed six distillation units for distilled water requirements.

In addition OIL has also commissioned the following equipments.

i) 7.5 MW capacity combined cycle power generation by utilizing waste heat from the exhaust of 14.45 MW Gas Turbine already installed at Duliajan.

ii) Solar powered street lights in Rajasthan areas.

3.5 Transportation Of Crude Oil

3.5.1 Transport of crude oil through pipelines is considered to be the most reliable and economic means of transport. In addition such a transport mode also prevents spills, wastage and thefts. In India by now, there are more than 20 big and small pipelines totaling in length to about 3400 Kms. there are however, a few locations where either due to the size of the oil field or its stage of development awaiting setting up of proper infrastructure, small quantities of crude oil is still being transported through tanks/truck lorries by road or through wagons by railways.

3.5.2 The crude oil pipelines in general, have pumping stations, repeater stations and terminals. The crude carrying efficiencies of the pipelines depend upon the types of crude these transport. Notwithstanding, the scope for energy conservation in these can exist which can be exploited by resorting to a number of steps chosen on case to case basis.

3.5.3 The main equipment involved in pipeline transportation are motor pumps and engines to drive pumps. Energy inputs to these installations are gas, diesel and electricity. OIL uses crude oil as fuel. Energy Conservation on these activities can be effected by :

a) Use of variable frequency drives for motors driving pumps. Pumps having variable load, when fitted with variable frequency drive starters can lead to significant energy saving.

b) Regular pigging operations (could be point to point pigging to reduce residues due to wax deposition which otherwise reduces the internal diameter of the pipeline).

c) Use of friction reducing chemicals/additives to improve the flow efficiency of the crude oil in the pipelines.

d) Looping : Increases the flow capacity without reduction in flow efficiency.

3.5.4 As such, the crude oil when properly treated, by heating or by addition of chemicals can increase the flow efficiencies and capacities of the pipeline.

3.5.5 For protection of the pipelines from corrosion, cathodic protection systems are usually employed. Both ONGC and OIL have resorted to use of solar photo-voltaic power for telemetric and telecommunication systems along with pipelines besides providing energy to the cathodic protection system.

.5.6 It is seen that proper maintenance and choosing the optimal plungers in the ump stations, considerable fuel economy is effected.

.6 Transportation Of Natural Gas

.6.1 The two organization ONGC and OIL produce both associated and non-assoiated gas which are to be transported to the consumers. In this the major contribution is by the arge amount of gas produced by ONGC in the Bombay Offshore region. ONGC has two major ubmarine trunk - pipelines, one connecting Bombay oilfield with Uran in Maharashtra, and the ther connecting South Bassein field to Hazira in Gujarat. There is yet another major gas ipeline which transports gas from Ankleshwar oilfield to Vadodara . Besides these, there are umerous small pipelines for the distribution system both under ONGC and OIL operations. hese are not important enough to be discussed here.

.6.2 With the setting up of GAIL the responsibility of transporting and distributing as in bulk quantities now rests with it.

.6.3 GAIL has successfully completed the Hazira Bijapur Jagdishpur pipeline, overing a distance of over 1700 Kms. and has been supplying gas to fertilizer plants, power lants and other industrial consumers along the pipeline. Four compressor stations at Hazira, habua, Vijaipur and Auriya have been located to boost the pressure of the gas (Plate No.4).

.6.4 Energy Conservation Areas

The following are the areas for energy conservation in transportation of gas :

) Compressor Stations

he prime mover for the gas compressors is gas turbine, and natural gas is used as fuel in the rbines. The fuel can be utilized efficiently with the following combination :

proper selection of gas turbine

GAIL has already selected and installed Aeroderivative model gas turbine in the four ompressor stations based on techno-economic considerations. The efficiency of aeroderivative odel of turbine is significantly higher than other industrial turbines.

ii) Waste Heat Recovery from Gas Turbine

The fuel gas is available from the gas turbine exhaust at a temperature of 510-540^{0}C in rder to maximize the efficient use of energy, GAIL proposes to provide waste heat recovery ystem to Vijaipur and install a steam turbine to generate electric power from the waste heat in as turbine exhaust. The waste heat available from gas processing plant at Vijaipur also will be tegrated with this scheme. The estimated net power output from this system without pplement firing is about 8.5 MW.

) Looping of Pipeline

To increase system capacity looping of pipeline may prove to be less expensive than installing additional compression power in many cases. Thus significant amount of fuel can be saved.

c) Maintenance of gas pipeline

Pigging of gas transmission pipelines is done primarily to maintain efficiency by cleaning the pipe. Downstream of compressor stations pipeline sections may require periodic pigging to remove condensate or lubricating oil coming from compressors. These can get accumulated in the pipeline and restrict flow. Also, slugs of liquids inadvertently injected into the pipeline will collect at low elevations and reduce flow efficiently. Therefore, periodic cleaning of the gas pipeline with help of PIGS will reduce the friction factor resulting in less pressure drop. The compressor power will be saved to certain extent due to the proper maintenance of pipelines.

d) Power recovery with expanders

With the installation of expanders near the consumer terminals in IPCL, Baroda; NTPC, Auriya; and NTPC, Dadri, power recovery can be made.

e) Internal coating of the pipeline

The friction factor becomes less with internal coating of the pipeline. This results in less pressure drop and less power requirement at booster stations. Also internal coating of the pipeline can increase the capacity of gas pipelines without adding compression horse power or looping a line. This can be done for future gas pipeline based on economic study.

f) Recovery of Gas

Compressors can be used to save natural gas that would otherwise be vented to the atmosphere whenever the gas pipe line is under maintenance. By using portable pulldown compressors, gas in the section to be isolated can be recovered and pumped into another line or routed back into the line downstream of the isolation valve.

g) Optimization of compressor station operations

Interruption in gas offtake by various consumers can result in higher operating pressure in the pipeline until corrective actions are taken for reducing load of compressors. Telemetric control makes it possible to take corrective actions as soon as variations in gas consumption are observed at the consumer end.

3.6.5 As stated before, of late, the responsibility of bulk distribution of gas has been given to GAIL, however, the smaller pipelines that were operated by ONGC and OIL are still being operated by the said organizations. In Assam, the gas transportation distribution, besides the smaller commitments made to these organizations, is the responsibility of Assam Gas companies Limited (AGCL).

4. Data Analysis And Information System

4.1 ONGC and OIL both have dedicated energy cells which are responsible for monitoring the consumption of energy in their various operational units. These cells also make specific recommendations when ever the energy consumption trends deviate from the desired path.
These cells also organize seminars, workshops and other awareness programmes. These cells also conduct studies on alternate sources of energy resulting in conserving electricity, Diesel fuel or Natural Gas. Better utilisation of Natural is also studied.
In order to have proper energy management in upstream organisations a regular inflow of data on properly designed formats and addressed to the appropriate authority, and passing through concerned channels is very essential and needs more stress. Appropriate authorization from top can lay desired emphasis on actions points. Though the norms and standards of energy consumption at macro level i.e. for each of the region and project are being monitored need is felt to do this exercise at micro level and the norms and standards for consumption of energy for each of the equipment, machinery etc. are required to be fixed and monitored.

4.2 EXISTING INFOSYSTEM

4.2.1 Oil India Limited's Monitoring Cells :

The main energy monitoring cell is located at OIL's headquarters, Duliajan and the Group General Manager is the senior most officer who overseas these functions. The hierarchical structure that exists is as given below :

Group General Manager (Operations) (Addl. Duty)

Chief Technical Auditor

Dy. Chief Technical Auditor

Planning Officers

There is a Planning Officer in each department.

4.2.2 Monitoring of energy consumption in projects outside the area of control of headquarters is carried out under the guidance and control of the General Managers of such projects.

2.3 The R&D Department is invariably involved, alongwith a few other partments, to study various proposals aimed to reducing consumption of energy. perimentations, if required are conducted in the R&D Departments and so are the studies for veloping fuel efficient devices and fuel efficient additives / equipments.

2.4 ONGC's Monitoring Cells :

ONGC's Monitoring Cells are overseen by the Director (Technical). He has an officer Group General Managers rank (GGM-EM) under him who is the overall coordinator of nservation efforts. The Energy Cell is located at the headquarters (Dehradun). The erarchical structure that exists is given below:

Director (Technical)

Group General manager (EM)

Energy Cell (HQ,Dehradun)

Energy Cells at each of the six regions
Viz., BRBC, NRBC, ERBC, CRBC, SRBC, WRBC
Under General Manager Technical

Energy Coordinators in each project

Business Group under Project Managers

Discussions with the officers of these organisations lead to suggestions for strengthening e organizational mechanism.

.2.5 The functions and some of the achievements of the cells are :

) collection of the energy consumption data for monitoring.
) induction of format for energy consumption it is intended that the installation wise data compiled at the regional level under the Regional Energy Coordinator (GM-Technical).

) The monitoring of the Regional Energy Data is done at the corporate level by the nergy Cell located at headquarters i.e. by Director(EM).

) The projects or areas are identified for application of proven technologies / methods eir implementations is regularly monitored by regional and headquarter monitoring cells. In ase pilot projects are undertaken the recommendations/feed back is provided at the all India vel through respective energy cells in regions and projects.

) Interaction among the various cells is to be carried out by internal meetings / periodical onferences to share the experience and expertise.

4.2.6 ONGC is already fixing targets of energy consumptions on territorial and regional basis.

4.2.7 The GAIL which has till now only limited operations is managing the conservation activities through their Technical Services Department under Director (Operations). However, with the growth in their activities they will have to properly structure their mechanism of conservation efforts.

4.2.8 Enquiries revealed that the officers engaged in these cells have had formal training of very short duration of one week in Energy Auditing for performing their functions more efficiently.

4.2.9 A few energy audits have been carried out at installations by external auditing agencies but these agencies are also not very much conversant with all the operations of the upstream sector.

4.3 Data Analysis

4.3.1 It is necessary to have adequate data to determine the existing trend of energy consumption and to plan for an effective control. The most important need therefore, is to create a data bank for energy consumption statistics.

4.3.2 Targets fixed for energy consumption on territorial and regional basis include:
Drilling Index:KWH / Meter of drilling
O&OEG Index : KWH / Ton of O&OEG production
OSV Index : KWH / Ton of cargo handled
Organisational Index : KWH / Ton of O&OEG

4.3.3 These indices due to increase in the secondary recovery of oil, addition of new installations, deeper drilling, lesser success rate and intensive surveys and explorations are increasing and likely to increase in the near future.

4.3.4 Data need to be organised at the (micro) equipment level as well as (macro) regional or territorial or organisational level. Reasons for variations have to be critically examined and inferences to be used for designing corrective action plan.

5.0 Energy Audit

5.1 A lot of publicity has already been given in these organisations to encourage energy conservation but not much is known about the specific ways and means to achieve the same. Energy Audit deals with this aspect at length.

5.1.1 Energy Audit is the key to a systematic approach for decision making in the area of energy management. It attempts to balance the total energy inputs with its use; and serves to identify all the energy streams in a facility. It quantifies energy usage according to its discrete functions.

5.1.2 Industrial Energy Audit is an effective tool in defining and pursuing comprehensive energy management programmes. In this field also the basic functions of management like planning, decision making organizing and controlling, apply equally as in any other management subject. These functions can be effectively performed, based on reliable information which can be made available to the top management by applying Energy Audit techniques.

5.2 The Need

5.2.1 With the advent of Energy crisis and exponential hikes in the cost of different forms of energy. Energy Audit is manifesting its due importance in various sector. Energy Audit will help to understand more about the ways energy and fuel are used in any industry and help in identifying the areas where waste can occur and where scope for improvement exists.

5.2.2 The Energy Audit would give a positive orientation to the energy cost reduction, preventive maintenance and quality control programmes which are vital for production and utility activities. Such an audit program will help to keep alive variations which occur in the energy costs, availability and reliability of supply of energy, decide on appropriate energy mix, identify energy conservation technologies, retrofits for energy conservation equipment and the like.

5.2.3 In general, Energy Audit is the translation of conservation ideas into realities, by blending technically feasible solutions with economic and other organizational considerations within a specified time frame. This technique will be more beneficial than piece-meal injection of short term measures, without adopting a scientifically evolved strategy including gearing up of organizational structure and other infrastructural requirements.

5.3 Type

5.3.1 Energy Audit attempts to balance total input of energy with its use. The type of Energy Audit to be performed depends on :

- the function and type of industry.
- the depth to which final audit is needed and
- the potential and magnitude of cost reduction desired.

5.3.2 The primary objective of Energy Audit is to determine ways to reduce energy consumption per unit of product output or to lower operating costs. The extent and type of Energy/Audit should result in gains commensurate with the efforts.

There can be two types of Energy Audit :

i) Preliminary Audit
ii) Detailed Audit

5.3.3 Preliminary Audit is performed in a limited span of time. It focuses on major energy supplies and demands, accounting for at least 70 percent of total energy requirements. The Detailed Audit goes beyond quantitative estimates to costs and saving. It includes engineering recommendations and well defined projects with priorities. It accounts for approximately 95 percent of energy utilized in the plant. A long range energy plan can be drawn up on the basis of data generated and analyzed.

5.3.4 The preliminary Audit can be an effective follow up for measuring the progress of the Plant Energy Management program(if any) that has been drawn up earlier. It may also form the basis for deciding the modalities of Detailed Audit.

5.4 Methodology

5.4.1 There is no set methodology which can be readily tailor adapted for conducting Energy Audit in all plants. What works in one plant may fail in another. It depends on the management philosophy, history and culture of organization, type of plant and machinery, financial conditions of the company and technological and process intricacies. In essence, Energy Audit directs and controls the energy management program. A general questionnaire is, however, given in **Appendix-I** which will help in identifying areas while carrying out an Energy Audit study. An energy management program which can be steered through a well conceived Energy Audit system is highlighted hereafter.

5.5 Prerequisites

5.5.1 Before starting any energy management program, the top management should assign the responsibilities of energy accounting auditing and analysis to an internal and/or an external group. The executives from various departments like production, utilities, maintenance and finance should be brought together in order to review the findings at periodic intervals.

5.5.2 Necessary financial, organizational and infrastructural support for implementing and reviewing energy conservation measures should be provided to this group.

5.5.3 The involvement of the representatives from different departments / labour unions is necessary to make the energy conservation measures effective.

5.6 Scope

5.6.1 The needs and objectives of the Energy Audit are to be identified. The functional areas to be studied are selected, based on overall energy consumption figures of the organization.

5.6.2 The scope of an Energy Audit varies according to the facilities being audited. At one extreme is a light manufacturing operation where lighting ventilation and air-conditioning are the major energy uses. While at the other end, there are integrated process units like refineries and petrochemical plants, where cascading of energy and complex energy balances are involved. The different scopes of Energy Audit are listed in following Table.

Table

Scope of Energy Audit :

- Analyze present consumption and past trends in detail.
- Review lighting requirements.
- Consider sub-metering.
- Compare standard consumption to actual.
- Produce an energy balance diagram for the firm.
- Review existing energy recording system.
- Compare consumption with other locations,other firms, previous period and budget
- Check records against invoice.
- Compare meter reading against records.
- Review records of maintenance engineer.
- Check capacities and efficiencies of equipments.
- Check working of controls.
- Examine need for automatic controls.
- Determine adequacy of maintenance.
- Review fuel storage and handling.
- Examine need for improved instrumentation.
- Consider training energy management staff.
- Review new projects with respect to energy use.
- Introduce life cycle costing.
- Consider changing the management information system
- to include energy parameters.
- Develop energy use indices to compare
- performance/productivity.
- Introduce energy use monitoring procedures.
- Check frequency of energy reporting systems.
- Examine and monitor new energy saving techniques.
- Examine need for energy saving incentives.
- Consider publicity campaigns and incentives.

5.7 Data Collection

5.7.1 Basic data concerning the overall energy consumption, its cost and production figures for a period of the preceding five years have to be collected. These figures, when compared give a trend of energy consumption and its cost per unit production over the years. The data can be complied in different formats. Energy Consumption in different forms, should be expressed in a common unit(Kcal/Kwh/GJ) to facilitate easy comparison. Table of energy conversion factors may be referred. As energy consumption is also related to production figures, it should be expressed in a common term viz., specific energy consumption - Kcal/unit of production.

5.7.2 The collection of data needs metering facilities for energy used in different sections/departments. A fair approximation of energy consumption in different processes/equipment can be make with the help of different standard data.

5.8 Data Analysis

5.8.1 When sufficient data has been built up, the existing records of consumption should be reviewed. The energy consumption and production figures available can be refined to an appropriate form.

5.8.2 A pictorial representation e.g. pie diagram, can be made to indicate the share of different forms of energy in the total energy consumption of the unit.

5.8.3 A graphical representation of energy input (in the form of oil equivalent) per unit of product (million Rupees) over the years will give an immediate insight into the trend of commercial energy consumption. An increasing trend will call for a serious involvement in holding the line.

5.8.4 A sankey diagram, showing balance of energy input and output, can be drawn for accounting energy use and losses in the plant. This can be accompanied by actions required for curtailing the consumption.

5.8.5 By making a graph of specific energy consumption against product output from a large number of readings or as a result of trials, it may be possible to pick out the best set of figures which can be used as a target for future output or to optimize the process for energy use. The comparison of specific energy consumption with similar units and/or a theoretical exercise for the same will also help in fixing targets.

5.8.5 A process flow diagram with energy consumption in each step/operation could be made which will indicate the order of energy consumption in different operations.

5.9 Energy Conservation Proposals

5.9.1 Energy Audit results in energy conservation proposals of projects. Initially, proposals with minimum investments are identified such as :

* Improvements in the standard maintenance of thermal insulation, instrumentation, combustion equipment etc.

* Carrying out of plant efficiency trials
* Excess air control
* Stopping leakages
* Reallocation of electric motors

5.9.2 The criteria used for ranking the proposals are the savings achievable from a project compared to the investments needed for effecting these savings. The savings to investment ratio (SIR) is calculated and the project with the highest SIR is selected first then the next highest and so on. Proposed projects, however, should provide an adequate financial return of the capital required to complete them. A discounted Cash Flow and/or Life Cycle Cost Analysis of the project should be carried out to get a complete economic analysis of the proposal. The following guidelines are recommended for approval of smaller size working budget type energy conservation projects.

Anticipated Real Project Life	Payback
5 years	2 years
10 years	3 years
15 years	4 years

5.9.3 An effective campaign on educating the employees in the unit by way of posters, house magazines, suggestion box, involvement of unions, training programmes and incentive schemes should be given conservation attitude.

5.10 Control

5.10.1 A reporting system of energy consumption should be devised and incorporated in the Management information systems. This will help in evaluating and programmes implemented.

5.10.2 This necessarily calls for proper metering system at key points. The reliability of the data is most important. It, otherwise would jeopardize the whole exercise. The data thus generated will give a clear picture of the status of different energy conservation proposals/projects against the targeted value. It leaves enough room to reorganize the programmes accordingly, if the results are found far short of the target.

5.11 Periodicity Of The Audit

5.11.1 It is too much to expect a common answer to the question of periodicity of Energy Audit. It depends on the type of audit undertaken previously, pace of implementation of energy conservation program in the recent past, overall potential for energy conservation and several other factors. It can be better decided by professionals involved in the latest Energy Audit exercise undertaken in the plant or on the basis of a preliminary audit, specially being undertaken for the above purpose. However, for a beginning the periodicity, once in 2 to 3 years would be adequate.

5.12 Energy Audit 'An Effective Tool'

5.12.1 Energy Audit is an effective tool in defining and pursuing a comprehensive energy management program. A careful audit of any type will give the unit a plan with which it can effectively manage the plant energy system at minimum energy costs. This approach would be useful for industries in combating escalating energy costs and also reap several other benefits like improved production, better quality, higher profits, lower emission etc. The approach would broadly be the same in any type of industry and service. The basic formats may have to be suitably modified for different type of industries.

APPENDIX-I

Format for Prilimanary Energy Audit/Inspection for upstream sector industry.

SECTION - A

I FUEL SYSTEM

1. Condition of storage tank : Good/Satisfactory/Bad
2. Leakage in pipe : High/Low/No leakage
3. Measuring system availability : Yes/No
4. Flow meter : Yes/No
5. Availability of filter and condition of filter : Yes/No & Good/Bad
6. Storage of lube oil/condition of lube oil : Good/Bad
7. Lube oil analysis kit availability : Yes/No
8. Condition monitoring of lube oil : Followed/Not followed
9. Quantity of waste oil collected and its use : Disposed/Reused
10. Housekeeping, cleanliness and spillage etc. if any : Good/Satisfactory/Bad

II POWER PACKS :

1. Power Pack no. & sl. no. Engine & sl. no. alternator
2. Leakage of fuel in the line : High/Low/No leakage

3. Leakage of oil in oil line : High/Low/No leakage

4. Leakage of water in water line : High/Low/No leakage

5. House keeping : Good/Satisfactory/Bad

6. Maintenance of Radiators : Good/Satisfactory/Bad

7. Other maintenance done as per schedule : Done/Not done

8. Water temperature : Normal/Abnormal

9. Condition of exhaust smoke : Normal/Abnormal

10. Record of diesel consumption : Available/Not available

11. Record of lube oil consumption : Available/Not available

12. Record of running Hours : Available/Not available

13. Record of KW,KVA,VS operation : Available/Not available

14. Record of energy meter reading : Available/Not available

15. Condition of alternator : Good Satisfactory/Bad

16. Actuator no load current within limits : Yes/No

17. Condition of lighting circuit : Good Satisfactory/Bad

18. Leakage of air : High/Low/No leakage

19. Condition of filter and strainer : Good Satisfactory/Bad

20. Scale formation in the water circuit in engines, radiator etc. : Yes/No

III Control Room :

A DCPCR (Direct current Power Controll Room)

1. Condition of A/c in terms of efficient cooling : Good/Satisfactory/Bad

2. Leakage of A/c if any : Yes/No

3. Calibration of meter : Done/Not done

4. Condition of power LT (Low Tension) PCB (Printed Circuit Board) & level of power LT Set : Good Satisfactory/Bad

5. House Keeping : Good Satisfactory/Bad

6. Earth leakage Relay available : Yes/No

B ACPCR (Alternating current Power Controll Room)

1. Condition of A/c (Air Conditioners) in terms of efficient cooling : Good Satisfactory/Bad

2. Leakage in A/c if any : Yes/No

3. Load Balance in all the Phases: Yes/No

4. Meter Condition/calibration : Good Satisfactory/Bad

5. House Keeping : Good Satisfactory/Bad

6. Earth leakage Relay available : Yes/No

IV COMPRESSOR HOUSE

1. Condition of the equipment : Good/Satisfactory/Bad

2. Leakage of air : High/Low/No leakage

3. Condition of filter & strainer : Good/Satisfactory/Bad

4. House keeping : Good/Satisfactory/Bad

5. Leak test carried out : Done/Not done
Date :

6. Lighting : Good/Satisfactory/Bad

7. Leakage of oil : High/Low/No leakage

8. Drier condition : Good/Satisfactory/Bad

V DRAW-WORKS/DERRICK

1. Leakage of air : High/Low/No leakage

2. Leakage of oil : High/Low/No leakage

3. Leakage of water : High/Low/No leakage

4. Condition of meters on Derrick : Good/Satisfactory/Bad

5. Condition of instruments : Good/Satisfactory/Bad

6. House keeping : Good/Satisfactory/Bad

7. Lighting type & condition : Energy efficient / Non-energy efficient

8. Maintenance being done : Yes/No

9. DC motor maintenance carried out : Yes/No

10. Eddy current brake cooling water condition : Good/Satisfactory/Bad

11. De-scaling Done : Yes/No
period and Date :

12. BOP remote panel condition of lighting circuit : Good/Satisfactory/Bad

13. BOP remote panel & circuit condition: Good/Satisfactory/Bad
& leakage of air : High/Low/No leakage

14. Air winch air connection & : Good/Satisfactory/Bad
leakage : High/Low/No leakage

15. Derrick floor lighting. Mast lighting condition : Good/Satisfactory/Bad

VI MUD PUMPS

1. Type of mud pump : PT 850 / PT 1100
2. Condition of mud pump : Good/Satisfactory/Bad
3. Condition of Aux motors pumps : Good/Satisfactory/Bad
4. Condition of DC Motor : Good/Satisfactory/Bad
5. Super charger motor/pump condition : Good/Satisfactory/Bad
6. USE of correct liner size for various hole sizes of drilling : Yes/No
7. Spillage of lubricant : High/Low/No leakage
8. Leakage of mud : High/Low/No leakage
9. Leakage of water : High/Low/No leakage
10. Scheduled maintenance carried out : Yes/No

VII MUD SYSTEM

1. No. of active tanks
2. No. of reserve tanks
3. No. of water tank
4. Condition of water pump : Good/Satisfactory/Bad
   & any leakage : High/Low/No leakage
5. Condition of agitators : Good/Satisfactory/Bad
6. Condition of Hopper pumps and : Good/Satisfactory/Bad
   any leakage : High/Low/No leakage
7. Condition of De-sander & De-silter : Good/Satisfactory/Bad
   pumps & leakage : High/Low/No leakage
8. Condition of shale shaker : Good/Satisfactory/Bad
   & de-gasser & leakage : High/Low/No leakage
9. Condition of trip tank & trip : Good/Satisfactory/Bad
   tank pumps & leakage : High/Low/No leakage

10. Lighting system in the area : Good/Satisfactory/Bad

VIII OFFICE BUNK HOUSE & DRILL SITE AREA

1. Lighting in the D/s bunk houses & A/c condition : Good/Satisfactory/Bad

2. Street light condition : Good/Satisfactory/Bad
& usage of Energy Efficient lamps : Yes/No

3. Wastage of energy in lights, heater etc. in & office bunk houses : Yes/No

4. Welding generator set condition : Good/Satisfactory/Bad

5. Welding transformer/rectifier set condition : Good/Satisfactory/Bad

6. Use of diesel compressor for lifting ground water etc. : Yes/No

IX DSA (Drill Site Accomodation)

1. DG SET :

1.1 Maintenance carried out : Yes/No

1.2 House Keeping : Good/Satisfactory/Bad

1.3 Leakage : High/Low/No leakage

1.4 Records Maintained : Yes/No

1.5 Per day consumption :
Norm / past consumption : High/Low/As per Norm

1.6 Street light condition : Good/Satisfactory/Bad

1.7 No. of tube lights & condition :

1.8 No. of cooling appliances :
excluding A/c & condition : Good/Satisfactory/Bad

1.9 No. of A/cs

2.0 No. of Geyser :

2.1 No. of Grinders :

2.2 No. of bunk houses :

2.3 No. of Hot Plate & Wattages :

2.4 No. of exhaust fans and HP :

2.5 No. of ceiling fans :

2.6 No. of pumps and HP :

X RENEWABLE SOURCES OF ENERGY

1. Solar : Yes/No

2. Wind : Yes/No

3. Natural Gas : Yes/No

4. Geothermal : Yes/No

5. Ocean : Yes/No

XI AWARENESS :

a. Stickers / Posters are available : Yes/No

b. Literatures are available : Yes/No

c. Training/Seminar attended etc. : Yes/No
No. of trained persons :
No. of persons yet to be trained :

SECTION B

1. Name plate details of major equipments to be collected on separate sheet and annexure to the main report.

2. Any other data of fuel consumption etc. may be recorded on Separate paper and annexure.

3. Status of Energy Consumption projects installed & details may be kept as annexure.

6.0 Conservation And Utilization Of Natural Gas

6.1 Until about early 70s, the natural gas had not been paid sufficient attention, nor the requisite investments for its development and utilization were regularly made. Consequently the gas that was produced alongwith the crude oil was not fully utilized and significant quantities of it were usually flared. The two oil price shocks during the 70s brought home the realization about the great use that natural gas could be put to, both as fuel and as feedstock, particularly in such situations of restricted and costly oil supplies.

6.2 In the recent years, natural gas has rapidly emerged as a premium source for fuel, as well as, feedstock and is expected to progressively replace the use of liquid hydrocarbons, in a number of places and in a variety of ways. Its demand has, consequently increased several folds. Coincidentally over last 10 years, the estimates of the supply potential in India have also increased significantly. As a result, the gas use is expected to increase from the current level of 27 million standard cubic metres per day (MMSCMD), by the year 2000 A.D. Inspite of such a large increase in availability, the potential demand for generation of power, for industrial use, LPG and as feedstock for fertilizers and for petrochemicals is likely to be in excess of the supply.

6.3 It is obvious that effective steps are warranted both for conservation and utilization of natural gas. Flaring of gas has got to be therefore, reduced - if not completely stopped as early as possible. A review of the present situation and future prospects about the demand supply of petroleum products, inclusive of gas, has revealed that not only the produced gas should be used judiciously to derive the maximum benefits to the economy. Formation of a National Gas Use Policy is, therefore, urgently warranted. In the present context, however, the following aspects required immediate attention :

a) measures to contain gas flaring;

b) Utilization of gas for displacement of petroleum products which are short in supply.

6.4 Flaring of valuable hydrocarbons in a situation of overall scarcity is clearly unacceptable. An analysis to ascertain the reasons for non utilization/flaring and measures to eliminate/reduce these significantly have to be identified and carried out.

a) WESTERN OFFSHORE

Over the last few years, the gas oil ratio (GOR) has increased unexpectedly, and there were no approved plans for meeting such a contingency, Fortunately, and as distinct from other regions, market in this region is not a constraint. There are a large number of fall back consumers in Maharashtra (ex-Uran) as also in Gujarat (ex-Hazira) and if the gas pipeline system in the region could be integrated and inter linked gas could be brought to land, at either end of the Hazira or Uran and properly utilized.

b) ASSAM

Unlike Western offshore, this area suffers from an inadequacy of market. This has been the main cause for gas to be flared. To make the matters worse, even the existing consumers have not been taking their full quota regularly and this has lead to fluctuations in offtake leading to further flaring of gas.

A detailed study carried out by OIL in respect of the offtake pattern of gas by various consumers indicates wide seasonal, daily and even hourly fluctuations in the offtake. On the annual basis upliftment of gas has been of the order of 70% of the commitment made by the consumers. As said above this adds to the flaring. In order to cater to this kind of situation an Underground Storage cum Flowback Scheme has been formulated and is being implemented by OIL. According to this scheme, during the periods of lean offtake, the associated gas will be injected into a few properly selected underground reservoirs. The stored gas could be produced back during the peak demand periods.

A few oil collection stations/group gathering stations, gas at very low pressure become available from the last stage of separators. Most of this is unavoidably flared. However, here again as and when it has been possible, some gas flaring has been reduced by deployment of low pressure booster compressors. In absence of a full fledged gas transmission network intra-organization or inter-organisation (ONGC/OIL) - flexibility in gas transmission does not exist. This deprives the organizations of some further scope of reducing gas flaring. The gas from the fields newly discovered or located in farflung areas has also to be unavoidably flared. The gas injection projects, in both the organization; those that have already been implemented, as well as the new schemes, planned for pressure maintenance, will enable substantial conservation of gas. To ensure optimal gas utilization a close control on the natural gas utilization, production and distribution in the different field is exercised. Installation of a computer based Supervisory Control and Data Acquisition System (SCADA) has already been introduced to achieve this objective. ONGC, OIL and GAIL have proposals in this area for further utilization of gas by setting up proper distribution and optimum utilization facilities (LPG etc).

c) GUJARAT

Unavoidable flaring of low pressure gas from the last stage of separators, remoteness of the field from established infrastructure etc. lead to natural gas flaring. More importantly it is the absence of inter linking gas distribution system that offers the biggest constraint. Most of these are not intractable problems, and are being progressively taken care of. In order to avoid any flaring and putting the gas to optimal utilization, compression and transportation facilities have already been identified. The low pressure gas in remotely places area may still have to be flared unless crude oil production is reduced an option which may not be easily acceptable.

6.6 Gas As Substitute Of Liquid Petroleum Products ; Conservation Of Petroleum Products

As has been stated before, natural gas is finding growing utilization by substituting liquid petroleum products in all the sectors of the economy such as domestic sector (gas replacing LPG - replacing kerosene); power sector (gas - replacing Naphtha/furnace oil); agricultural sector (gas based fertilizers) and in the industrial sector (in control temperature furnace: sponge iron) its application in the transport sector has, however, remained unrealized. Presently there are a number of options available for gas derived/gas converted products to replace diesel/gasoline in the transport sector. These are :

i) Use of Methanol/Ethanol;

ii) LPG and
iii) Compressed Natural Gas (CNG).
iv) Liquified natural gas (LNG)

6.7 In addition, a part of the natural gas liquids (NGL) can be used for generation of motor gasoline through reformer.

6.8 Nearly each of the above stated options for displacing diesel/motor gasoline in the transport sector involves frontier technologies. While the feasibility of such conversion and substitution exists beyond doubts, the viability of the substitution required detailed studies/analysis. A number of organizations within the petroleum sector viz. ONGC, OIL,GAIL and IBP are continuously engaged in carrying out such studies.

7.0 Vapour Absorption Chilling System for Air Conditioning Requirements.

7.1 Present System

7.1.1 Air Conditioning (A/C) requirements on the offshore process platforms of ONGC are of the order of 600 to 800 tons of cooling and heating and which are presently met by 5 to 6 units of 100 to 120 ton capacity including the standby requirements.

7.1.2 This Air conditioning is presently done by vapour compressor chilling system using normally reciprocating gas compressors, driven by an electric motor. A/C plant load is a major load on any electric system and to meet this 600 to 800 ton load of Air conditioning, power requirements for these compressors could be of the order of 750 HP to 900 HP (on an average 120 ton A/C compressor is fitted with 150 HP(110 KW) electric motor).

7.1.3 Natural Gas fired or waste heat recovery type vapour absorption chilling systems for air conditioning requirements are now available. The systems are working on low pressure steam, which can be generated either by Natural Gas firing or by waste heat recovery from gas turbine exhaust system.

7.2 Vapour Absorption Chilling System For Air Conditioning

7.2.1 Vapour absorption chilling system is an energy conservation device which operates on Heat energy, either received from waste gases of Gas turbine exhaust or through direct firing of Natural Gas instead of using electricity.

7.3 Basic Principle

7.3.1 The system is based on Lithium Bromide (LiBr) - Water cycle and is based on three facts :

a) Boiling temperature of water is a function of pressure at atmospheric pressure the water boils at 100° C and boiling temperature of water at 6 mm of Hg absolute pressure is as low as 4°C.

b) As concentration of LiBr increases its affinity to water increases and decreases with increase in temperature.

c) There is large difference in vapour pressure of LiBr & Water.

7.3.2 In Vapour absorption chilling machines water works as a refrigerant (which evaporates in the evaporator to cause effective cooling) and lithium bromide is used as absorber for water. The process of absorption increases evaporation of water, resulting in effective cooling of the refregerant. Water vapours are absorbed in the absorber by lithium bromide solution and when the solution is saturated with water it is pumped into the generator where it is heated to drive away watervapour from the solution. Schematic diagram of vapour absorption chilling system is shown in plate - 6.

7.3.3 Dry lithium Bromide is flown back to the absorber to absorbe water vapours once again after cooling. Hot water vapours from the generator are cooled in the condenser where vapours condense. Liquid water is then sprayed in the evaporator chamber where it evaporates drawing the latent heat of vapour from the surrounding. Fresh water is used to used to supply this latent heat which, in turn, is circulated through air handling unit to cool the air and cause cooling of the space desired.

7.3.4 It helps in effectively utilising the natural gas which is being flared off at some installations. The use of natural gas will also help in reducing our dependence on electricity and at the same time also reduce the maximum demand of electricity so that more loads can be connected within the installed generating capacity.

7.3.5 In developed nations the Vapour absorption chillers are being used more extensively in comparison to Vapour compression system. The vapour absorption chiller system is a proven technology and is being extensively used in place of conventional vapour compression system.

7.3.6 ONGC has recently introduced gas fired vapour absorption chilling technology in its Eastern Region Business Center (ERBC), for air conditioning of Regional office Building (ROB) and Guest House at Nazira, so as to give thrust to energy conservation. It has been observed that the gas fired vapour absorption chillers are effective and can be used in place of conventional units for air conditioning.

7.4 Benefits of vapour absorption system over vapour compression

7.4.1 The main advantages of usng gas fired vapour absorption chillers are :

- Virtually free from moving parts except for small liquid centrifugal pumps.
- Noiseless operation and vibration free.
- Highly reliable & negligible maintenance due to no moving parts.
- Environment friendly.
- Can be used as split system as only chilled water comes to Air Handling Unit.
- Continuous and stepless capacity control.
- Working substance is LiBr & Water, no make up is required & working medium is non toxic.
- Not dependent on electric power, but on low reassure steam.
- Will reduce overall electric load on power system.
- Cost slightly higher, but pays back within 2 years or so, appears to be very attractive for offshore platforms.
- Indigenously available & proven technology.

7.5 Suggestion :

7.5.1 A techno-economic study for specific requirements at offshore platforms may be conducted first by inhouse Engineers in consultation with manufacturers like M/s Blue Star and

M/s Voltas. In case it is found feasible for offshore operation, Engineering and Construction (E&C) Division, Bombay may take decision for installing such system at offshore installations.

7.6 Energy Saving Analysis and Cost Analysis

7.6.1 An energy saving analysis and cost analysis has been carried out for a 90 TN system.

7.6.2 Following assumptions are made in both the cases:

a) The machines have a running of 8000 hours per year
b) Cost of gas is Rs 750 / 1000 m3
c) Cost of electricity is Rs 2.40 / KWH

7.7 Energy Saving Analysis

A. Gas fired system

i.	Power consumption of 90 TN direct gas fired machine	2 KWH
ii.	Cost of electricity per year (2 x 8000 x 2.40 Hrs.)	Rs. 38,400 /-
iii.	Gas consumption per year (32 M3 per Hr x 8000 Hrs.)	2,56,000 m3 per year
iv.	Cost of gas @ 750 / 1000 M3	Rs. 1,92,000 /-

B. Electrical system

i.	Power consumption of 90 TN conventional reciprocating machine	108 KWH
ii.	Cost of electricity / year (108 x 8000 x 2.40)	Rs. 20,73,600 /-

Net Savings in opertational cost (20,73,600 - 1,92,000 - 38,400)	Rs. 18,43,200 /-

7.8 Cost Analysis

A. Capital Cost

i.	Capital cost of gas fired system	Rs. 48 lakhs
ii.	Capital cost of electrical system	Rs. 25 lakhs
iii.	Additional cost of gas fired system	Rs. 23 lakhs
iv.	Considering interest,depreciation and Operation and maintenance cost (about 25 % of capital cost) i.e 25 % of Rs. 23 lakhs	Rs. 5.75 lakhs

the additional cost per year for gas
fired system

B. Operation Cost

a. Electrical System
i. Electricity cost Rs. 259 / hr
(108 KWH x 2.40 / KWH)
ii. Freon Gas Rs. 6 / hr
(120 kg @ Rs. 400 / kg)
in 8000 hrs

Rs. 265 / hr
----

b. Gas Fired System
i. Electricity cost Rs. 4.80 / hr
(2 KWH x 2.40 / KWH)
ii. Gas consumption cost Rs. 28.80 / hr
(32 M3 / hr x .75)

Rs. 33.60 / hr
----

c. Saving in operational cost for gas fired system Rs. 231.40 / hr
or
Rs. 18.51 lakhs/year

d. Net saving if gas fired system is installed Rs. 12.76 lakhs/year
(Rs. 18.51 - Rs. 5.75 lakhs)

7.9 Issues Involved:

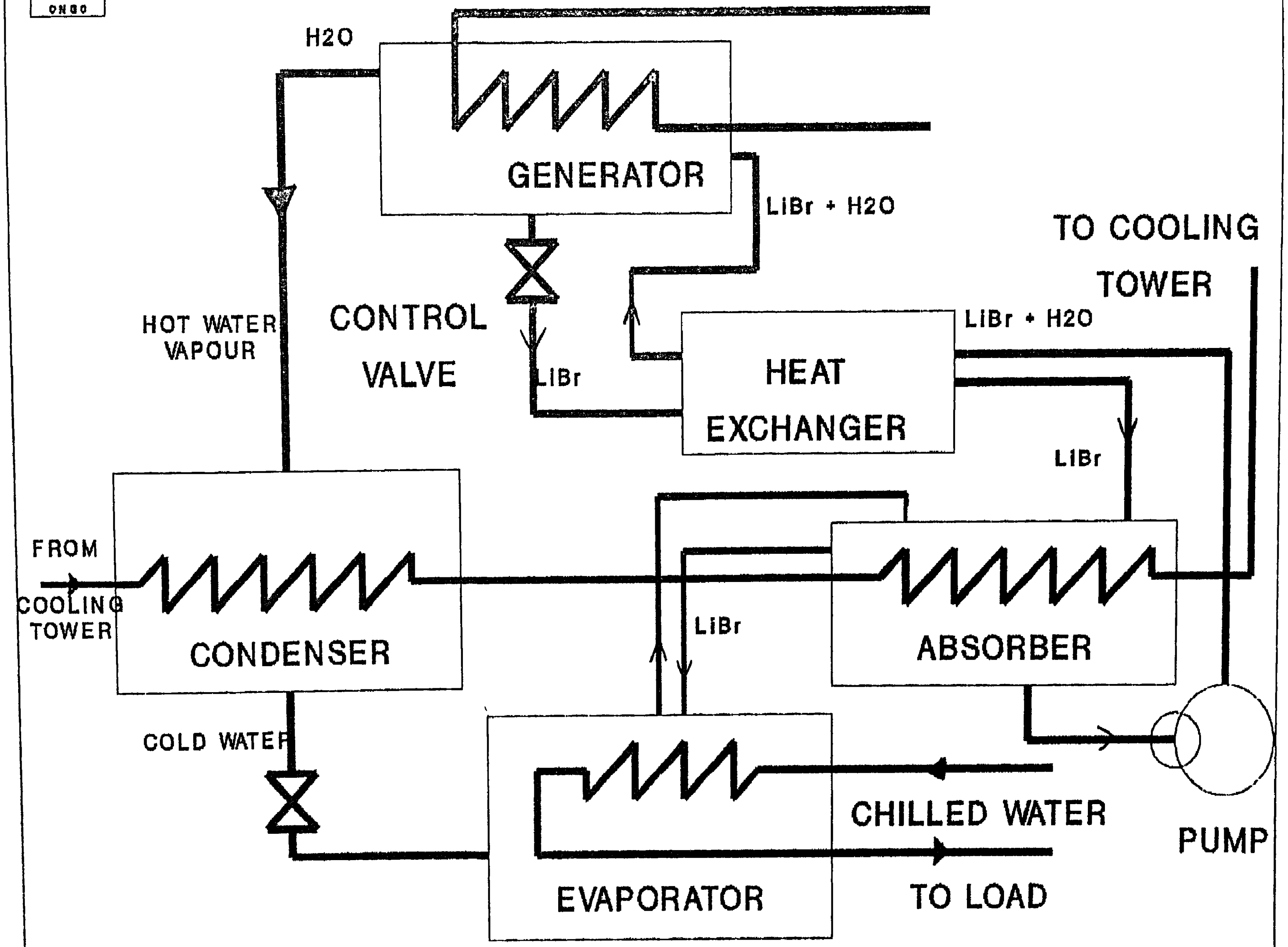
I) Weight of vapour absorption chilling system need to be accomodated on the offshore platforms which need to be studied.

ii) Life of the existing centrifugal type chillers need to be taken care of while evaluating economic benefits for repacement.

iii)Availability of waste heat need to be studied and accordingly supplementary gas firing facility to be provided.

iv) Safety measures in view of flame proof and explosion proof locations to be taken care of.

SCHEMATIC DIAGRAM OF VAPOUR ABSORPTION COOLING SYSTEM



8.0 Energy Conservation In Steam Net-Work

8.1 Steam plays a vital role for process heating and turbine drive in Oil Industry. With increase in energy cost, it becomes essential to conserve energy in steam network, upto maximum extent possible, by minimizing the heat loss, by selecting / replacing with efficient steam users and by optimizing steam distribution network. Some of the aspects in this direction have been outlined , such as :

- Modeling and optimization of steam system.
- Proper insulation of steam network.
- Efficient use of steam-straps and condensate recovery system.
- Use of back pressure and extraction type steam turbines.
- Minimizing steam venting.
- Generation of power during pressure step-down.
- Recovery of LP steam by flashing HP/MP condensate.
- Supply of steam at requisite pressure and temperature level to users.
- Proper selection and maintenance of steam users.

8.2 Modeling And Optimizing A Steam System

An Efficient Steam System Is Extremely Important in over all economics of process plants.

Steam distribution system determines the various steam header pressures, temperature and flow requirements to effectively meet the various users requirements.

8.3. Energy Conservation Through Proper Insulation Of Steam Pipes

Heatloss from uninsulated and poorly insulated steam-pipes, is extremely high. Application of proper insulation and its regular maintenance can save about 10% of energy consumed by Boilers. With increasing energy costs, increased insulation gives a greater return on investment than increasing Boiler capacity. Therefore, in developed countries, insulation cost is moving up from its traditional 2% of total steam plant costs to figures ranging from 4 to 8%.

For uninsulated steam pipes or steam pipes, whose insulation is severely damaged, the yearly heatloss is quite substantial.

8.3.1 Insulation Economics

Insulation system design and installation are given more engineering thoughts, since the economic calculation are more critical. Following points must be considered in economic calculations :

- Upgradation : Continuous upgrading the type of insulation being used in steam network, makes sure the energy saving through out the life of the steam plant.
- Selection : Selection of the right type of insulation for the particular service temperature is important.

- Application : Proper application of insulation increase its life.
- Metallic Jacketing : Metallic jackets are invariably applied on steam pipes to provide protection against weather mechanical damage and fire and allowing no leakage of water. Mostly Aluminium jacketing is provided for steam net work.
- Engineered Insulation : Greater use of engineered insulation, combination of layers of different insulations leads to more economy.
- Use of fabricated form of insulation, designed for application at difficult areas, such as valves, flanges and other pipe fittings.

8.3.2 Insulation Material

Good insulation material is of low chloride content, chemically inert, non-sulphurous, rot proof, vermin proof, impervious to hot water and steam, non injurious to health and non-corrosive.

i) For steam network, the operating temperature range varies from 100^0C to 800^0C. Suitable insulation material for this temperature range are :

- Fibrous material (rock wool and glass wool) :
  Suitable upto 550C.
- Rigid material (Calcium silicate and cellular glass) : Cellular glass is suitable upto a temperature of 425C. But in view of high thermal conductivity its use is limited. Calcium silicate blocks are suitable for all temperatures.

ii) Jacketing material : Aluminium jackets are invariably used as weather protection. Thickness varies from 0.71mm to 1.22 mm. Cladding is to be coated with bitumen anticorrosive paint on the side in contact with insulation.

iii) For fibrous material insulation, metal mesh is used to hold the insulation in right place.

8.4. Energy Saving Through Efficient Use Of Steam Traps And Condensate Recovery System In Steam Network

8.4.1 In a steam network, condensate is formed whenever steam gives up its latent heat. The condensate must be removed from the system immediately after its formation for satisfactory operation of the system. In condensers, if the condensate is not removed, the heat transfer surface shall be water logged, reducing the heat transfer. Condensate formed in the saturated steam header's due to heat loss, may cause serious problem including water hammering, which damages piping.

8.4.2 The steam trap is an automatic device, capable of removing the condensate along with entrapped air from the steam network, without loss of live steam from the system.

8.4.3 The effective use of steam-trap in steam network, saves about 10% of the average plant's steam consumption. Following points must be considered to achieve the maximum benefit :

i) Correct sizing and selection of steam traps.
ii) Proper installation of the steam traps.

iii) Regular inspection, testing and maintenance of steam traps.

8.5.1 Correct Sizing and Selection of Steam Trap

Steam traps : Steam steam-traps are broadly classified into three basic categories, on the basis of the principles of their operation :

i) Mechanical Traps : Operate on difference in density between steam and condensate. The basis type are :

- Float & thermodynamic type
- Open-top bucket type
- Inverted bucket type

ii) Thermostatic traps : Operate on difference between steam temperature and cooler condensate temperature, utilizing an expansion below or bimetallic strip to operate the valve head. The basis types are :

- Balanced pressure thermostatic traps
- Liquid expansion traps
- Bimetallic traps

iii) Thermodynamic traps : Operate on Bernoulli's principle.

iv) Other types of steam traps :

- Impulse traps
- Fixed orifice traps.

Proper sizing and selection of a steam trap depends on following factors :

- Anticipated condensate loads
- Pressure differential across the trap
- Start up load
- Temperature of the condensate reaching the trap
- maximum allowable pressure
- Need to vent air or non-condensible gases
- Corrosive service
- Safety factor to use

8.5.2 Proper Installation of Steam Trap

The best selected and sized steam trap will not function correctly if the piping to and from it, is not properly designed and installed.

Following important aspects must be considered to ensure a trouble free installations :

- Inlet and discharge piping
- Double and group trapping
- Drain point
- Air binding
- Steam locking

- Water hammering
- Frost damage
- Lifting condensate
- Part load operation.

8.5.3 Inspection, Testing and Maintenance

Due to the very nature of its installations, steam trap forms a natural depositary for any dirt in the steam network. Since steam traps contain moving parts, eventuality for wear and tear exists. Therefore, regular inspection, testing and maintenance of steam traps is a must to keep them in proper working order.

8.5.4 Other Type of Condensate Recovery System

Since steam traps don't effectively handle a very large capacity of condensate, it is therefore, recommended to use a separator with a level control device to dispose of condensate of capacity 2 ton/hr or higher.

8.6 Energy Saving By Use Of Back Pressure And Extraction Type Steam Turbines

Since in a chemical process plant, steam at various levels are required by the process units, it is advisable to generate steam at maximum pressure / condition in Boiler and avail the steam at requisite pressure and quantity by using a back pressure extraction type turbine. The selection of the back pressure or extraction type turbine depends on following process inputs :

- Boiler pressure
- Various pressure level steam requirement by process units.
- Electric power requirements
- Cooling water availability.

Efficiency of a condensing type steam turbine is very low i.e. of the order of 25 to 30% since the major heat (i.e. latent heat) of steam is lost in outlet surface condenser. By using a back pressure type or extraction type turbine the efficiency increases upto 80%. Therefore, selection of back pressure or extraction type steam turbine must be given primary importance.

8.7 Energy Saving Through Minimizing Steam Venting

Size of orifice	Steam loss(kgs/month)
1/2"	379090
7/16"	289198
3/8"	213380
5/16"	147550
1/4"	95340
3/16"	53118
1/8"	23835

From the above table, it is evident that even the smallest orifice (i.e 1/8") can waste about 286 tones of live steam at 100 psig per year, which is equivalent to wastage of 18 tones of fuel oil per year. Therefore, devices like steam headers, steam traps and safety valves must undergo regular scheduled maintenance.

Leakage in steam header and user equipments occurs due to mechanical damage and due to corrosion. Corrosion in steam network can be eliminated by proper treatment of Boiler feed water. Free oxygen and formed carbon dioxide turn the condensate into a dilute acid which damages the steam system. Therefore, proper deaeration of boiler feed water is a must for good health of steam network.

8.8 Energy Saving Through Maximum Condensate Recovery

In the process of heating the process fluid, steam gives up its latent heat and condenses at operating pressure of the condensers. For efficient operation of condensers, condensate must be removed immediately after its formation. Since steam condenses at more than atmospheric pressure, condensate gets discharged at corresponding saturation temperature, which is always more than 100°C. Condensate recovery must be maximized for two reasons :

- Condensate contains substantial quantity of sensible heat, because of its high temperature.
- Condensate must be reused for steam production to reduce water make-up quantity.

For both of these reasons condensate recovery adds to economy.

8.9 Generation Of Power During Pressure Step Down

In chemical process industries, steam is required for various units at different pressure and temperature levels. Since steam is generated in Boiler Plant at a single high pressure level, step-down of steam by using pressure reducing desuperheating stations (PRDS), is required to meet various pressure & temperature level demands. During pressure step down, though the total energy remains unchanged, the pressure energy is not utilized for any useful work. For proper utilization of this pressure energy, steam is required to be stepped down in a back pressure type steam turbine for generation of power. Decision for use of a back pressure type steam turbine to effect efficient step down depends upon following parameters :

- Quantity of steam
- Step down pressure level
- Economic criteria

Step down by use of PRDS is unavoidable though it is uneconomical. Even after use of a steam turbine, mechanical Step down of a small quantity of steam is required to maintain the temperature levels of downstream fluid.

8.10 Recovery Of Lp Steam By Flashing Hp/Mp Condensate

High Pressure (HP) / Medium Pressure (MP) condensate is flashed to Low Pressure (LP) condensate, which is finally reused for Boiler feed water after deaeration. During flashing the LP steam is usually vented out. For optimum use of HP/MP condensate, it must be flashed at a requisite pressure to recover the LP steam, which is finally put to the LP steam header for further process use. Usually, for a chemical process plant, the requirement of LP steam is tremendous for heating and jacketing purpose, which is partly met by recovery of flash LP steam.

LP steam is also recovered from flashing of blow down water at an intermediate pressure before the atmospheric flashing.

8.11 Supply Of Steam At Requisite Pressure And Temperature Level To Users

For Efficient And Economic Operation Of Steam Users, Steam Must Be Supplied At A Predetermined Pressure And Temperature Level. By Supplying Steam At Lower Levels, The Users Donot Perform To The Desired Extent. Similarly Supplying Steam At Higher Levels, The Users Consume More Steam Than The Required Quantity. Higher Pressure And Temperature Not Only Leads To Higher Steam Consumption But Also Mechanically Damage The Equipment, If Safety Devices Fail To Operate. For Example, Steam Jet Ejectors And Soot Blowers Do Not Operate At All If Steam Is Supplied At Lower Pressure Levels And Ejectors Operate Adversely At Very High Steam Pressure.

8.12 Energy Conservation Through Proper Maintenance Of Steam Users

The major steam users in chemical process plants are: steam turbines, reboilers, condensers, steam heaters, distillation columns, hydrocrackers, soot blowers, steam-jet ejectors, atomization in burners etc. By selection of energy efficient users operating cost can be minimized. Proper maintenance of major users such as condensers, reboilers, steam heaters shall improve their heat transfer efficiency, since the performance of a heat transfer equipment slowly decreases due to fouling buildup during the course of operation. Therefore, regular cleaning (i.e. mechanical or chemical) of heat transfer surfaces saves energy. Apart from heat transfer equipments, steam jet ejectors and rotating steam users such as turbines must be regularly attended to as per suppliers operating instructions to get the best output from it.

9.0 Energy Efficient Heat Exchange

9.1. The galloping cost of energy has made it imperative for the design engineer to intensify his efforts to conserve energy at every opportunity. There is a significant potential for energy conservation in the exchange of heat between fluids.

9.2. Heat Recovery In Process Units

9.2.1 Energy conservation by means of trains or networks of heat exchangers is a common feature in most oil, petrochemical and chemical processing plants. The most common example is the crude preheat train in the crude distillation unit of an oil refinery in which the crude from storage is heated successively by the products and circulating reflux streams of the atmospheric and vacuum distillation columns. The final heating is carried out in a furnace and the crude then flashed in the atmospheric column.

9.3 Interchange Of Energy Between Different Process Units

9.3.1 The energy given up by a process stream in one unit may be recovered in another unit to preheat a feedstock or reboil a column bottom stream.

9.4 Recovery Of Energy To Generate Low Pressure Steam Or Preheat Boiler Feedwater

9.4.1 Condensers and coolers operating at fairly high temperatures such as 100^0 C and above can preheat boiler feedwater instead of rejecting the heat to cooling water, thereby conserving energy. Preheating of boiler feedwater is economical as the increase in the condenser cost due to the lower MTD is usually recovered in just a few months.

9.4.2 At somewhat higher temperature, even LP steam generation is possible.

9.5. Fouling Control

9.5.1 Fouling is the deposition of unwanted material on heat exchange surface causing a deterioration in performance. There are a number of processes that result in fouling particulate deposition, chemical reaction, corrosion, polymerisation and growth of marine organisms (biofouling). Fouling results in not only poorer thermal performance but in increased pressure drop too, due to partial blockage of the flow passages and thus has a direct bearing on the energy efficiency of the heat transfer equipment.

9.5.2 The fouling of a heat transfer surface is influenced by the nature and composition of the fluid, its velocity and temperature and the material of construction. Thus the determination of fouling resistance is extremely difficult and has necessarily to be established empirically. It is evidently important to minimise fouling on both the shellside and the tubeside to maximise the energy efficiency. The following rules will go a long way in order to achieve this goal.

9.5.3 Flow velocity should be kept as high as possible on both shellside and tubeside as this minimises all modes of fouling. This if particularly true of slurries.

9.5.4 Since the inside of tubes is easier to clean than the outside, the dirtier fluid should be allocated to the tubeside.

9.5.3 If a dirty fluid has to be allocated to the shellside, a well-proportioned baffle-spacing to shell ID ratio and should be employed to minimise stagnant regions where fouling is pronounced. The maximum baffle spacing to shell ID ratio recommended is 0.6 and the maximum baffle cut ratio 0.35.

9.5.4 Polymerisation fouling is particularly sensitive to wall temperature. For services involving polymerising fluids such as distillation column reboilers in butadine plants, a spare exchanger is recommended.

9.5.5 For mechanical cleaning of tubes from inside by rodding or hydroblasting, straight tubes are preferred as U-bends of U-tubes cannot be effectively cleaned.

For mechanical cleaning of the outside of tubes, square or rotated square pitch should be employed so as to provide cleaning lanes.

9.5.6 Finned tubes should be used with great caution if fouling is anticipated on the shellside.

9.5.7 Some types of exchangers foul less than others, depending primarily upon the degree of turbulence generated. Thus, plate exchangers foul less than shell and tube exchangers, considering both to be well designed. The corrugations on the plates of plate exchangers scour the surface and keep it clean. Spiral-plate and rod-baffle exchangers should also be considered for fouling services as their proclivity to fouling is less than conventional shell-and-tube exchangers. Spiral-plate exchangers are especially suited to handling slurries.

9.5.8 In thermosyphon reboilers, the amount vaporised should be restricted to 30-35% to minimise fouling.

9.5.9 There is recent evidence which suggests that the use of inserts of the wire fin type, besides improving the heat transfer coefficient, actually reduces fouling by heavy viscous fluids inside tubes. Fluidised-bed heat exchangers also reduce tubeside fouling dramatically.

9.5.10 On-line cleaning systems using brushes or balls virtually eliminate fouling by cooling water inside tubes and are widely used to considerable economic advantage in large condensers such as power plant steam surface condensers. Recently, stainless steel brushes have also been introduced for hydrocarbon service.

9.6. Power Saving In Aircoolers

9.6.1 Conventional aircoolers operate with constant-speed, constant-pitch fans which cannot vary the air flow and therefore their motors draw a constant electrical load. This results in excessive power consumption because control systems are available to decrease the air flow at lower ambient temperature, as follows :

- Manually or automatically operating louvers
- Switching fans on/off (manual or automatic) where multiple fans are used for a particular service.
- By passing on the process stream side (manual or automatic).
- Multi-speed motors (manual or automatic).
- Variable speed drivers (thyristor controlled).
- Autovariable fans

9.6.2 of these, the second, fourth, fifth and sixth methods result in energy saving. Autovariable fans operate with the minimum air flow and hence motor horse-power at all times for a fixed process outlet temperature. A pneumatically actuated diaphragm alters the blade pitch angle over a wide range even while the fan is in motion. Due to the energy saving effected, autovariable fans usually have a favourable pay-out period, especially in dry climates where there is a large temperature difference between day and night and through the year.

9.7. Optimisation Of Air And Water Cooling

9.7.1 Air coolers directly reject waste heat into the atmosphere whereas water cooling requires an elaborate indirect system with cooling tower, make-up water, treatment etc. Although aircoolers themselves are much costlier than water coolers, the total system cost has to be compared for an economic evaluation. Generally, a combination of cooling by air and water is the cheapest but the break-point of the process fluid between air and water cooling has to be established for each project.

9.8. Use Of High-Flux Tubes

9.8.1 Boiling heat transfer coefficient is a strong function of temperature difference. At very low temperature difference such as 2-5^0 F across the boiling film, bare tubes cannot sustain nucleate boiling so that heat transfer is by natural convection only resulting in extremely poor heat transfer coefficient. Hi-flux tubes licensed by Union Carbide Corporation incorporate a highly efficient boiling surface composed of a thin metal matrix bonded to a tubular substrate. This special surface provided the stable, re-entrant cavities that are required for nucleate boiling and thereby promotes boiling heat transfer coefficients from 2 to 8 times greater than conventional surfaces at low Ùt.

9.8.2 With hi-flux tubes, it is possible to accomplish a given heat duty with a lower heat transfer area than with bare tubes or alternatively with a lower temperature differential for the same heat transfer area. For a service involving the boiling of a refrigerant, a lower temperature differential will lead to saving in compression horse-power. This hi-flux tubes may be used to advantage to conserve energy.

10.0 Co-Generation And Combined Cycle Power Plants An Efficient Way To Generate Power

10.1 Energy in the form of electricity and steam is the basic input for any industrial process. Considering the limited stock and increase cost of fossil fuels, particularly the mineral oil and natural gas, conservation of energy and its use in the most efficient ways, has become utmost important. In this context co-generation and combined cycle power plants have drawn attention of todays energy planners, because of the following characteristics :

- Maximum efficiency
- High reliability
- Use of various types of fuels
- Low operating cost
- Power generation at minimum cost
- Low maintenance cost
- Low Nox emission

10.1.1 A typical gas or fuel oil based co-generation system comprises of, a gas turbine generator (GTG) for generating power; a heat recovery steam generator (HRSG) for generating steam for GT exhaust gas; and a team turbine for generation of electricity from the surplus steam. If all steam produced is utilized for generation of power, the system is called combined cycle power plant.

10.2. Efficiency Of Gt Based Co-Generation And Combined Cycle Power Plant

10.2.1 The gas turbines in open cycle mode operate with an efficiency of 25% to 33% and on combined cycle mode (i.e. gas turbine and steam turbine) with an efficiency of 45% to 50% on full load operation; whereas the Co-generation systems utilize the available energy in fuel with an efficiency in the range of 90%. On the other hand the conventional direct fired boiler based power plants operate with an efficiency of only 25 to 30%. Looking at the more attractive features of combined cycle plants, constant research and improvements are being made by gas turbine manufacturers to further enhance the power output and efficiencies, making them still more attractive. Besides machine oriented features for improvement, the other methods being investigated & tried to improve system efficiencies are :

10.2.2 Inlet Air Cooling To Improve The Efficiency

Power output and the efficiency of a gas turbine is dependent on compressor inlet air temperature. About 30% of a typical machine's power output is lost as the ambient temperature climbs to 45^0 C, from 15^0 C (ISO conditions). Inclusion of a chilled water cooler at compressor inlet, reduces the air intake temperature closer to ISO conditions and increases the power output and efficiency of the machine. This process of enhancement of power generation can reduce the number of machines required thereby reducing the capital (fixed) investment as well as operating cost of the system.

The chilled water coolers can be direct or indirect contact type. Direct contact coolers are cheaper and cause low pressure drop, but extensive make-up and treatment are the disadvantages. Indirect contact coolers, similar to radiators, are of finned copper tube construction. Chillers for production of chilled water are either mechanical type, which are handicapped because of their high electricity consumption or vapour absorption type. The vapour absorption type chillers are highly economical since it uses low grade heat. Refrigerants can be ammonia or lithium bromide.

It has been found that the addition of vapour absorption type chilling arrangement proves viable both in terms of net power balance (after considering power use for chilling) as well as costs.

10.2.3 Use of Steam Injected Gas Turbines

In steam injected gas turbines (STIG), the power output and the efficiency of the turbine increases by injection of a part of the steam produced in HRSG, into gas turbine. The increase in gas mass flow and its specific heat results in higher power output. In addition to increased output, steam injection in gas turbine, essentially diminishes the formation of pollutants like nitrogen oxides (Nox) which is becoming a vital criterion for specifying equipment these days.

10.2.4 Minimizing the Back-Pressure

Back pressure affect the power output as well as the efficiency of the gas turbine. The downstream equipment i.e. HRSG etc. must be sized for a low pressure drop to effect a low back pressure for the gas turbine to maximize its output and efficiency.

10.3. Fuels For Gas Turbine

10.3.1 The ideal fuel for gas turbine firing is natural gas, the refinery fuel gas and the distillate fuel oil. But the improved version gas turbines are also suitable for residual fuel oil and synthesis gas derived from coal and wood. Gas turbines can be single or dual fuel firing type. Special burners are being developed for low Nox emission.

10.3.2 There are variety of fuels that can be used but would need treatment before use. The detailed treatment of same can be referred to in various literature and manufacturer's guidelines.

10.4 Various Components Of A Gt Based Co-Generation And Combined Cycle Power Plant.

10.4.1 The major components of a GT based co-generation or combined cycle power plants are:

i) Gas turbine generator (GTG)
ii) Heat recovery steam generator(HRSG)
iii) Steam turbine generator (STG)

besides various other components like diverter damper, stack & bypass stack, ducting surface condenser ejector, electrical distribution, controls and instrumentation etc.

10.4.2 Gas Turbine Generator (GTG)

The electrical generator coupled to the gas turbine is driven either directly or through a suitable speed reduction gear. Gas turbines in unit sizes range from 0.5 MW to 150 MW.

The fuel is fired in the combustor. The combustor usually operates at 10-20 kg/cm^2g and $1100\text{-}1200^0$ C. The hot gas emerging out of combustor at high temperature and pressure, drives the turbine-shaft by converting a part of the thermal energy into mechanical energy. Finally the exhaust gas leaves the turbine at a temperature of 450^0C to 550^0C.

10.4.3 Heat Recovery Steam Generator

The sensible heat from the Gas turbine exhaust gas is recovered in the Heat Recovery Steam Generator(HRSG) by raising steam. In a co-generation system or combined cycle power plant, steam at single or upto three different pressure levels can be generated in HRSG to effectively meet the various needs. The high pressure steam is generally used for electric power generation in steam turbine or meets special process requirements. The medium pressure steam can be injected into the gas turbine or used for process purposes. The low pressure steam is generally used for deaeration of boiler feed water or preheating of boiler feed water of to meet process requirements.

On the principle of water circulation, the HRSGs again are classified into three categories (i.e. forced circulation, natural circulation and assisted circulation). Mostly natural circulation type HRSG is preferred, because of its low operating cost and low maintenance.

If more steam is required to be generated from HRSG than what can be generated by simple recovery of GT exhaust waste heat, the HRSG is provided with supplementary firing systems (i.e. duct burners or burner mounted in HRSG casing). Since the gas turbine exhaust gas contains around 15% of oxygen, this gas serves the purpose of combustion air and thereby the capacity and efficiency of HRSG increases with supplementary firing. The extent of supplementary firing is generally limited to flue gas temperature of $700\text{-}750^0C$ at HRSG inlet. Provisions can also be made to operate HRSG at near full load on FD fan mode, for maintaining the steam supply in absence of GT exhaust gas. In this mode of operation the HRSG operates at a lower efficiency compared to that of a utility boiler.

It can thus be appreciated that the HRSG plays a vital role in the overall configuration of a co-generation or combined cycle power plant, and is not only the key to effectively utilize waste heat from GT exhaust gases, but with proper selection of supplementary firing, can effectively turn the plant into a self contained and sustained unit.

10.4.4 Steam Turbines Generator (STG)

A steam turbine is a heat engine that transforms heat into kinetic energy and can be grouped into four categories :

i) Non-condensing or Back pressure type
ii) Condensing type
iii) Condensing extraction type
iv) Condensing extraction type

Back pressure steam turbine exhausts steam at higher pressure suitable for process applications. In extraction type steam turbines, steam at intermediate pressures is extracted to meet various pressure level requirements. Since in a process plants, steam at various levels are required by process units, it is advisable to generate steam at maximum desired pressure condition in HRSG and avail the steam at requisite pressure and quantity by using a back pressure extraction type turbine. The selection of the back pressure or extraction type turbines in a co-geneartion plant depends upon following process inputs.

- HRSG pressure
- Various pressure levels of steam requirement by the process units.
- Electric power requirements
- Cooling water availability

Efficiency of a condensing type steam turbine is very low i.e. 25 to 30%, since the major heat (i.e. latent heat) is lost in outlet surface condenser. By using a back pressure or extraction type turbine the efficiency increases upto 80% provided extracted steam has a process use. Power to heat ratios for condensing type steam turbines varies from 35 to 75 KWH/Million BTU at full load operation. The extraction/condensing turbines confer operating flexibility for varying steam and electrical loads.

10.5 Feasibility Of Co-Generation System

10.5.1 The evaluation of feasibility of a co-generation plant for any particular process plant involves technical economic environmental and regulatory issue. A preliminary analysis involves three basic steps viz. data base development, performance assessment and economic analysis. Data base development includes total electricity consumption with internally generated and purchased break-up; total fuel consumption and types for generating electricity; total steam consumption at various pressure and temperature levels; total steam generation with its pressure and temperature levels; the fuel and exhaust gas data for each process. On the basis of these data, the co-generation scheme is conceptualized which meets the process requirements with best possible efficiency (i.e. with minimum fuel consumption).

An economic analysis is also needed to ascertain the cost effectiveness of the system.

10.6 GT Based Cogenergation System - Need Of The Day

Gas turbine based co-generation system and combined cycle power plants have a low pay-back period and with availability of natural gas/refinery fuel gas/distillate fuel oil, the cost of generation of electricity (Rs/KW) is the minimum for gas turbine based power plant when compared to Diesel Generator based and direct fired boiler based power plants. In addition to these advantages, fuel is most efficiently used in gas turbine based plants.

As Natural gas is easily available in the upstream sector, there is urgent need to consider generation of power through co- generation which is the need of the day.

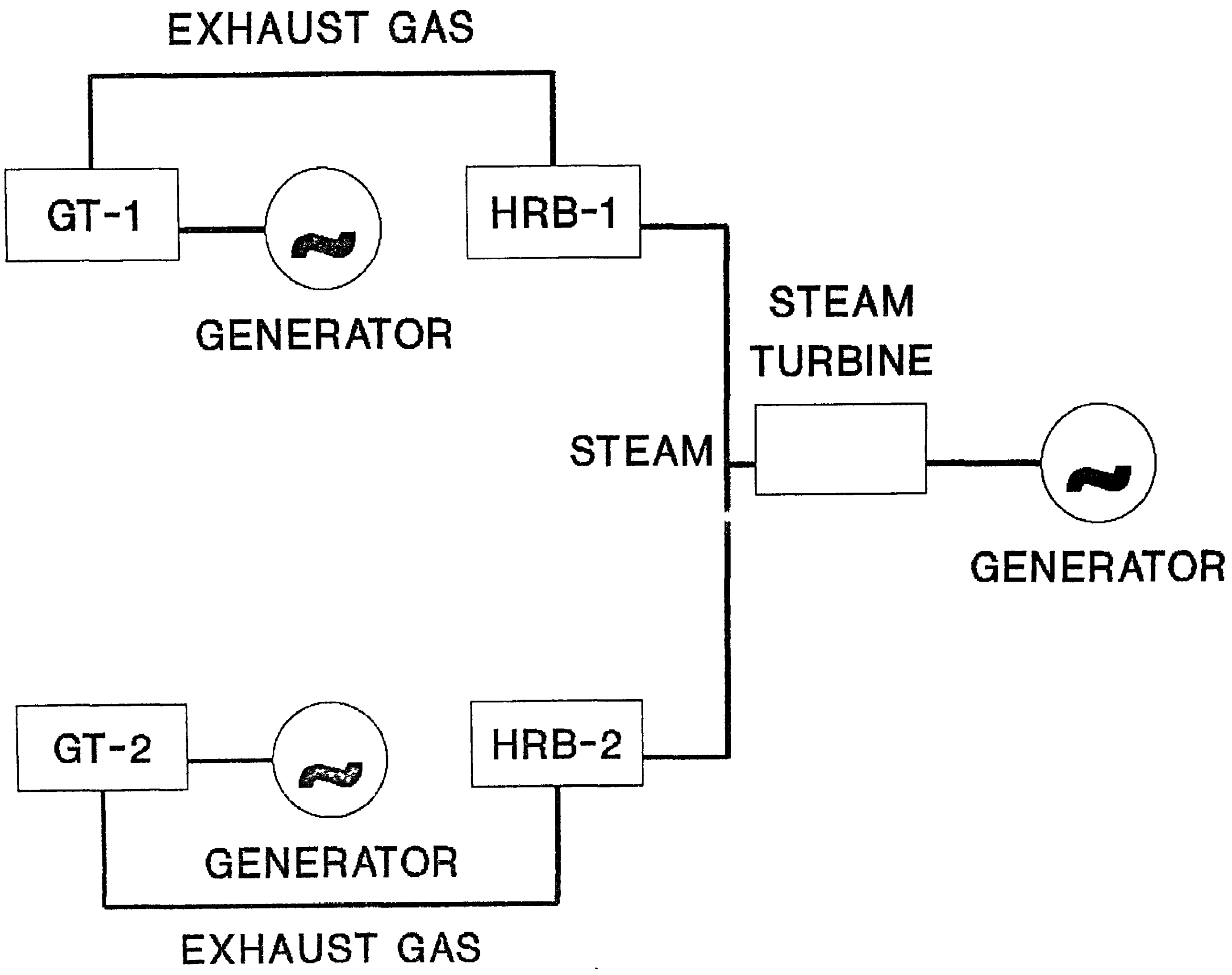


FIG: COMBINED CYCLE POWER PLANT

11.0 WIND POWER

11.1 Wind Energy by its very nature is available free, is not subject to any price escalation, will not be exhausted and, of course, is environment friendly. The production and use of wind energy neither pollute the atmosphere in any way nor it leads to global warming.

11.2 The upstream petroleum companies use electrical energy for production installation and other purposes mainly from the respective state electricity boards. Their demand is likely to increase in the coming years because of secondary recovery of oil.

11.3 Judging from the power scenario, the future is not certain. Electricity boards may not be able to release such quantum of power in future easily. Keeping in view, to go for own power generation, especially when cheap power, in the form of wind energy is available, is a good option.

11.4 Keeping pace with the changes taking place in the power sector, wind energy is proving to be a very much viable option. A bunch of incentives viz sales tax exemption/ deferment, income tax incentives (Details at annex-I) are being offered by central and state governments. State electricity boards are offering 'wheeling of power option' at a 2% nominal wheeling charge.

11.5 The technology of setting up wind farms is well established in India now. The present capacity of wind farms is around 700 MW in INDIA. Nodal agencies for wind farm generation in various states is given at annex-2. List of manufacturers of wind turbines in India is given at annexure-3. Costing cash flow and Net Present Value statements for 5 MW wind power generating farm are placed at annexure 4-5-6.

11.6 Though some incentives like sales tax benefits offered are valid only upto the specified dates by the state & central governments. Keeping in view the worst scenario the study shows that project is viable and its net present value is positive.

11.7 Keeping in view the vast potential of wind energy and its cost effectiveness, it is proposed for upstream companies to go for this project.

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Fax : 079-460987

KARNATAKA

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P.B. 5555, Malleswaram West
BANGALORE - 560 055
Tel. : 080-3322111, 3322771
Fax : 080-3326787, 3322496, 3326170

MAHARASHTRA

REPL Engineering Ltd.
Cookvel Building
Plot No. D-6, St. No. 20
MIDC-Marol, Andheri (East)
MUMBAI - 400 093
Tel. : 022-8216891, 8217174
Fax : 022-8216890

Windia Power Ltd.
26, Gobind Mahal
86/B Netaji Subhash Road
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Tel. : 022-6182314, 6182315
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Enercon (India) Ltd.
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Vestas RRB India Ltd.
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TTG Industries
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NEPC-Micon Ltd.
No.36, Wallajah Road
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CHENNAI - 600 002
Tel. : 044-8525041,8525870
Fax : 044-8522553

Das Lagerwey Windturbines
No.35(SP), Guindy Industrial Estate
CHENNAI - 600 032
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Tel : 044-2348724 Fax : 044-2348727

Arul Mariamman Textiles Ltd.
23, Kamarya Road
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POLLACHI - 642 002,
Tel. : 04259-4466
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Pioneer Asia Wind Turbines Ltd.
774, Anna Nagar
MADURAI - 625 020
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SMALL HYDRO POWER SYSTEMS

ASSAM

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Rural Electrification Corporation Ltd.
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7, Lodhi Road
NEW DELHI - 110 003

Chairman & Managing Director
Industrial Finance Corporation
of India
Bank of Baroda Building
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Risk Capital & Tech. Finance
Corp. Ltd.
Andhra Association Building
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Asst. Vice President
Infrastructure Leasing & Finance
Scheme - Delhi
4th Floor, East Court Zone
Lodhi Road,
NEW DELHI - 110 003
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MAHARASHTRA

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Industrial Development
Bank of India
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Managing Director
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Nariman Point
MUMBAI - 400 021
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Fax : 022-2854474

Managing Director
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1101, Dalamal Towers
Nariman Point
MUMBAI-400 021
Tel. : 022-2856053
Fax : 022-2825417

KARNATAKA

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Golden Towers, Airport Road
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Gujarat Industrial Investment
Corporation Ltd.
Chunibhai Chambers
Behind Dipali Cinema
Ashram Road
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Fax : 079-6568561

UTTAR PRADESH

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Pradeshiya Industrial & Investment
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PICUP Bhawan, Gomti Nagar
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Fax : 0522-3901236

WEST BENGAL

Chairman & Managing Director
Industrial Reconstruction
Bank of India, 19, N.S. Road
CALCUTTA - 700 001
Fax : 033-207182

Sl.no	Description	year -->	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	terminal
I	OUTFLOWS:																						
A	CAPITAL INVESTMENT																						
1		GROSS INVESTMENT	265.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-9.00
2		IREDA LOAN SALES TAX SHIELD	-198.75	19.88	19.88	19.88	19.88	19.88	19.88	19.88	19.88	19.88	19.88										
		NETT ONGC INVESTMENT	66.25	19.88	19.88	19.88	19.88	19.88	19.88	19.88	19.88	19.88	19.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-9.00
B	REVENUE PAYMENTS																						
1	LEASING CHARGES FOR 132 HECTARES RS 5000 PER HECTARE		0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
		1.50																					
2	O&M CHGS	1.5% OF TTL PJT COST #	4.00	4.39	4.83	5.32	5.85	6.43	7.08	7.79	8.56	9.42	10.36	11.40	12.54	13.79	15.17	16.69	18.36	20.19	22.21	24.43	
3		INTEREST PAYMENTS [INT RATE 16%]	31.8	28.6	25.4	22.3	19.1	15.9	12.7	9.5	6.4	3.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	TOTAL OUTFLOW [A+B]		102.75	53.59	50.85	48.15	45.50	42.91	40.37	37.90	35.50	33.18	30.94	12.10	13.24	14.49	15.87	17.39	19.06	20.89	22.91	25.13	-8.30
II	INFLOWS																						
A	REVENUE INCOME :																						
1	NET UNITS AVAILABLE FOR CONSUMPTION IN MILLION KWH [5% drop every 5 yrs]		5.30	5.30	5.30	5.30	5.30	5.04	5.04	5.04	5.04	5.04	4.78	4.78	4.78	4.78	4.78	4.54	4.54	4.54	4.54	4.54	
2	UNIT RATE SAVING [IN RS/KWH] #		5.40	5.94	6.53	7.19	7.91	8.70	9.57	10.52	11.58	12.73	14.01	15.41	16.95	18.64	20.51	22.56	24.81	27.29	30.02	33.03	
3	INCOME [SALES REVENUE] [1*2]		28.62	31.48	34.63	38.09	41.90	43.79	48.17	52.98	58.28	64.11	67.00	73.69	81.06	89.17	98.09	102.50	112.75	124.03	136.43	150.07	
4	TAX SHIELD (@35%) #		95.51	0.78	-1.28	-3.44	-5.70	-7.26	-9.68	-12.24	-14.93	-17.78	-19.58	-21.56	-23.74	-26.14	-28.78	-29.79	-32.79	-36.10	-39.73	-43.73	-2.91
5	TOTAL INFLOW [3+4]		124.13	31.48	34.63	38.09	41.90	36.52	38.48	40.75	43.35	46.33	47.42	52.14	57.33	63.03	69.31	72.71	79.96	87.93	96.70	106.34	-2.91
III	NET CASH INFLOW		21.38	-22.11	-16.22	-10.06	-3.60	-6.38	-1.89	2.85	7.85	13.15	16.48	40.04	44.09	48.54	53.44	55.32	60.90	67.04	73.79	81.21	5.40
IV	DISCOUNTED CASH FLOW [@12% p a]		21.38	-19.74	-12.93	-7.16	-2.29	-3.62	-0.96	1.29	3.17	4.74	5.31	11.51	11.32	11.12	10.94	10.11	9.93	9.76	9.60	9.43	0.56
V	NET PRESENT VALUE		83.47																				
VI	CUMULATIVE CASH FLOW		21.38	-0.73	-16.95	-27.00	-30.61	-36.99	-38.88	-36.03	-28.18	-15.03	1.45	41.49	85.58	134.12	187.56	242.88	303.79	370.82	444.61	525.82	531.22
VII	CUMULATIVE DCF		21.38	1.64	-11.29	-18.45	-20.74	-24.36	-25.32	-24.03	-20.86	-16.11	-10.81	0.70	12.02	23.14	34.08	44.19	54.12	63.88	73.48	82.91	83.47

NOTE 1 10 % escalation every year in rate and O&M chgs.
2. five year tax holiday on profits and gains from operations

.no	Description year -->	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	termnal
	OUTFLOWS:																					
	CAPITAL INVESTMENT :																					
1	GROSS INVESTMENT·	265.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
2	IREDA LOAN	-198.75	19.88	19.88	19.88	19.88	19.88	19.88	19.88	19.88	19.88	19.88										
	SALES TAX SHIELD	-119.25	19.88	19.88	19.88	19.88	19.88	19.88														
	NETT ONGC INVESTMENT:	-53.00	39.75	39.75	39.75	39.75	39.75	39.75	19.88	19.88	19.88	19.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
3	REVENUE PAYMENTS																					
1	LEASING CHARGES FOR 132 HECTARES· RS 5000 PER HECTARE	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	
2	O&M CHGS 2.0% OF TTL PJT COST #	5.30	5.83	6.41	7.05	7.76	8.54	9.39	10.33	11.36	12.50	13.75	15.12	16.63	18.30	20.13	22.14	24.35	26.79	29.47	32.41	
3	INTEREST PAYMENTS .	0.0	31.8	28.6	25.4	22.3	19.1	15.9	12.7	9.5	6.4	3.2										
	TOTAL OUTFLOW [A+B]	-47.00	78.08	75.48	72.94	70.47	68.07	65.74	43.62	41.48	39.43	37.50	15.82	17.33	19.00	20.83	22.84	25.05	27.49	30.17	33.11	
II	INFLOWS																					
A	REVENUE INCOME :																					
1	NET UNITS AVAILABLE FOR CONSUMPTION IN MILLION KWH [5% drop every 5 yrs]	6.70	6.70	6.70	6.70	6.70	6.37	6.37	6.37	6.37	6.37	6.05	6.05	6.05	6.05	6.05	5.74	5.74	5.74	5.74	5.74	
2	UNIT RATE SAVING [IN RS/KWH] #	5.40	5.94	6.53	7.19	7.91	8.70	9.57	10.52	11.58	12.73	14.01	15.41	16.95	18.64	20.51	22.56	24.81	27.29	30.02	33.03	
3	INCOME [SALES REVENUE] [1*2]	36.18	39.80	43.78	48.16	52.97	55.35	60.89	66.98	73.68	81.05	84.69	93.16	102.48	112.73	124.00	129.58	142.54	156.79	172.47	189.71	
4	INCOME TAX SHIELD (@35%) #	82.19	-0.51	-2.82	-5.24	-7.79	-9.46	-12.22	-15.13	-18.23	-21.52	-23.47	-27.07	-29.80	-32.80	-36.11	-37.36	-41.12	-45.26	-49.81	-54.81	
5	TOTAL INFLOW [3+4]	118.37	39.80	43.78	48.16	52.97	45.89	48.67	51.85	55.45	59.52	61.22	66.09	72.68	79.92	87.89	92.22	101.42	111.53	122.66	134.90	
III	NET CASH INFLOW	165.37	-38.28	-31.71	-24.79	-17.50	-22.17	-17.06	8.23	13.97	20.09	23.72	50.27	55.34	60.92	67.06	69.38	76.36	84.05	92.50	101.79	
IV	DISCOUNTED CASH FLOW [@12% p a]	165.37	-34.18	-25.28	-17.64	-11.12	-12.58	-8.65	3.72	5.64	7.25	7.64	14.45	14.21	13.96	13.72	12.68	12.46	12.24	12.03	11.82	
V	NET PRESENT VALUE	197.73																				
VI	CUMULATIVE CASH FLOW	165.37	127.09	95.38	70.59	53.09	30.92	13.85	22.08	36.05	56.15	79.86	130.13	185.48	246.40	313.46	382.84	459.20	543.25	635.74	737.53	737.53
VII	CUMULATIVE DCF	165.37	131.19	105.91	88.27	77.15	64.56	55.92	59.64	65.28	72.53	80.17	94.62	108.82	122.78	136.51	149.18	161.64	173.88	185.91	197.73	197.73

NOTE 1 10 % escalation every year in rate and O&M chgs
2 five year tax holiday on profits and gains from operations

Sl.no	Description	year -->	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	termnal
I	OUTFLOWS																						
A	CAPITAL INVESTMENT																						
1		GROSS INVESTMENT	265.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-9.00
2		IREDA LOAN	-198.75	19.88	19.88	19.88	19.88	19.88	19.88	19.88	19.88	19.88	19.88										
		SALES TAX SHIELD	-119.25	19.88	19.88	19.88	19.88	19.88	19.88														
		NETT ONGC INVESTMENT	-53.00	39.75	39.75	39.75	39.75	39.75	39.75	19.88	19.88	19.88	19.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-9.00
B	REVENUE PAYMENTS																						
1	LEASING CHARGES FOR 132 HECTARES: RS 5000 PER HECTARE		0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
2	O&M CHGS	1.5% OF TTL PJT COST #	4.00	4.39	4.83	5.32	5.85	6.43	7.08	7.79	8.56	9.42	10.36	11.40	12.54	13.79	15.17	16.69	18.36	20.19	22.21	24.43	
3		INTEREST PAYMENTS [INT RATE 16%]	31.8	28.6	25.4	22.3	19.1	15.9	12.7	9.5	6.4	3.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	TOTAL OUTFLOW [A+B]		-16.51	73.46	70.72	68.03	65.38	62.78	60.25	37.90	35.50	33.18	30.94	12.10	13.24	14.49	15.87	17.39	19.06	20.89	22.91	25.13	-8.30
II	INFLOWS																						
A	REVENUE INCOME :																						
1	NET UNITS AVAILABLE FOR CONSUMPTION IN MILLION KWH [5% drop every 5 yrs]		6.70	6.70	6.70	6.70	6.70	6.37	6.37	6.37	6.37	6.37	6.05	6.05	6.05	6.05	6.05	5.74	5.74	5.74	5.74	5.74	
2	UNIT RATE SAVING [IN RS/KWH] #		5.40	5.94	6.53	7.19	7.91	8.70	9.57	10.52	11.58	12.73	14.01	15.41	16.95	18.64	20.51	22.56	24.81	27.29	30.02	33.03	
3	INCOME [SALES REVENUE] [1*2]		36.18	39.80	43.78	48.16	52.97	55.35	60.89	66.98	73.68	81.05	84.69	93.16	102.48	112.73	124.00	129.58	142.54	156.79	172.47	189.71	
4	TAX SHIELD (@35%) #		92.86	-2.13	-4.48	-6.96	-9.57	-11.31	-14.14	-17.13	-20.32	-23.71	-25.77	-28.37	-31.23	-34.38	-37.84	-39.27	-43.22	-47.56	-52.34	-57.60	-2.91
5	TOTAL INFLOW [3+4]		129.04	39.80	43.78	48.16	52.97	44.04	46.75	49.85	53.36	57.33	58.92	64.79	71.24	78.34	86.15	90.31	99.32	109.23	120.12	132.11	-2.91
III	NET CASH INFLOW		145.55	-33.67	-26.95	-19.87	-12.41	-18.74	-13.49	11.95	17.86	24.16	27.98	52.69	58.01	63.85	70.28	72.92	80.26	88.33	97.21	106.98	5.40
IV	DISCOUNTED CASH FLOW [@12% p a]		145.55	-30.06	-21.48	-14.14	-7.89	-10.63	-6.84	5.40	7.21	8.71	9.01	15.15	14.89	14.63	14.38	13.32	13.09	12.87	12.64	12.42	0.56
V	NET PRESENT VALUE		208.79																				
VI	CUMULATIVE CASH FLOW		145.55	111.88	84.93	65.06	52.65	33.91	20.42	32.36	50.22	74.38	102.37	155.06	213.06	276.91	347.20	420.12	500.38	588.71	685.92	792.90	798.30
VII	CUMULATIVE DCF		145.55	115.49	94.00	79.86	71.97	61.34	54.50	59.91	67.12	75.83	84.84	99.99	114.88	129.51	143.89	157.22	170.31	183.17	195.81	208.24	208.79

NOTE 1. 10 % escalation every year in rate and O&M chgs
2. five year tax holiday on profits and gains from operations

12. Conclusions And Recommendations

12.1 Conclusions

12.1.1 The upstream activities in the oil industry like exploration production and transportation of oil and natural gas are not very energy intensive. The individual operations, equipments and installations do not require large energy inputs. However, given regard to the scale of operations that are spread over the entire country and employ large fleet of vehicles; drilling rigs; a fairly large number of oil and gas transportation pipelines; processing installations etc the total consumption of energy and, therefore, the scope of saving appears quite significant.

12.1.2 The Upstream petroleum sector produces the most important energy resources - oil and natural gas and therefore, it is imperative that they have to not only regulate and minimize their energy requirements but have also to conserve the oil and gas produced by them by avoiding all kinds of wastage, including flaring of gas.

12.1.3 It is seen that in surveys economy in energy consumption can be effected by proper maintenance of vehicles, good driving practices by replacing less fuel efficient vehicles by more fuel efficient vehicles; proper planning of the survey operations - avoiding unnecessary repeating trips; and lastly by monitoring and controlling the consumption of POL at different points. In drilling more efficient electrical rigs are slowly replacing the old diesel/mechanical rigs. This is a move in right direction. Scope exists presently in optimizing engine running hours and in maintenance and proper use of engines. Diesel/crude oil savings can be effected by replacing their use as lubricants in the drilling mud by chemical additives. It is also seen that the waste heat from engine exhausts can also, to certain extent, be gainfully utilized. In production installation (Process Platforms/CTF, CGS etc) by preventing spillage, leakages, gas flaring etc. waste of oil and gas can be prevented. In storage tanks the vapour formations leading to loss of lighter hydrocarbons can also be prevented/recovered. In the offshore platforms natural gas is being used for generating electricity. The waste heat of the gas turbines is being used for generation of process steam and potable water. Both the organizations use a formidable logistic system comprising large fleets of vehicles, offshore supply vessels, helicopters etc. Winch filled special oil field trucks which are capable of loading / offloading heavy equipments without the help of cranes etc. can be used. This helps in reduction in the number of transport equipments in shifting the rigs from one place to other thereby reducing consumption of POL. The Offices, Institutes, Hostels and other work-centers require utility services for lighting, lifts, air conditioning, hot water, domestic fuel. The input of energy to these utilities are in form of electricity, diesel and natural gas. A few modifications and certain innovative steps, including use of non conventional energy sources can effect saving of electricity and POL. In transportation of crude oil and gas again the scope of conservation lies in plugging the leaks, preventing spillage, and other kind of wastage. Besides, pumping stations and compression stations are areas warranting specific attention for optimizing en consumption. Maintenance of pipelines, pipeline-pigging and looping can lead to a more en efficient/cost effective transportation. Treating and dosing of crude with flow improvers/ reducers also improves the flow efficiency in a crude pipeline. It is seen that there has be spurt in number of onland early production systems (EPS). Crude is such cases, barring a exceptions, has to be transported either by road or rail. Such a mode of transport is neither effective nor energy efficient, and as such, it does not make sense to stretch it beyond a poin

Both ONGC and OIL have got energy cells which act as nuclei for information re and transmission of instructions. OIL has introduced SCADA system for intimate monito of gas production, consumption and distribution.. At present however, the mechanism app quite adequate. GAIL has set up a Technical Conservation Group at Vijaipur Compre Station and a Gas Processing Complex which carried out energy related activities, inclusi monitoring and auditing. They will have to set up such groups at each of the new compl presently under planning.

12.1.4 Due to various reasons some gas is being flared. Gas has gained growing import both as premium fuel and feedstock and props up the nations's hopes in reducing impo petroleum products considerably by replacing their demand. An appropriate gas use poli the most important requirement of the day for ensuring most optimal use of gas in sustainin developmental activities. Investments are required, from time to time, for eliminating flaring of gas, or at-least reducing it to the minimum.

12.1.5 Although the organization have initiated with all the sincerity of purpose, actio conservation of energy, it is found that the mechanism and the organizational systems still scope for improvements. Regular inflow of energy consumption data from various centers, covering individual activities, equipments and installations, is a must to create a s data bank/base on which further conservation efforts can be planned and attempted. Inspi some efforts the norms and standards for various equipments, installation and machinery not yet been derived.

12.1.6 Effective steps for carrying out energy audits at various work units are yet taken. The establishment of energy cells both by ONGC and OIL is a laudable effort. T are , however, manned by officers most of who have not received formal training in carryin energy audits. Outside agencies, competent to carry out such audits, have not yet pr fruitful.

12.2 RECOMMENDATIONS

12.2.1 Management of energy information acquisition, storage and analysis

It is necessary to have adequate data to determine the existing trend of energy consumpti various work units and to plan for an effective control on consumption. The most impo need, therefore, appears to be the creation of data bank for energy consumption statistics. Subsequently, it is necessary to establish a data base wherein such consumption statistics is segregated area-wise, activity-wise and, if possible equipment/plant wise. For doing so it is recommended that :

a) An accepted common approach is adopted by both ONGC and OIL for preparation of data sheets for energy consumption.

b) A computerized data bank is created and a data base is evolved.

c) Norms for energy consumption are fixed for installations, activity centers etc. to the extent it is possible to do so.

d) Based on above, actions for energy budgeting and preparation of energy balance sheets are initiated.

e) Periodic reviews of energy consumption should be carried out in regions (projects and major installations) and at the Headquarter.

f) Intra regional and inter regional comparisons for energy consumption at similar work centers are made.

g) Analysis for variations in consumption should be carried out and reasons for such variations determined.

h) Corrective actions and remedial measures be evolved once the reasons for variation in energy consumption are identified.

12.2.2 Improvements in the mechanism for implementing energy conservation measures

In order to achieve better results from energy conservation programme it would be necessary that the data acquisition, data analysis and monitoring are carried out by persons who are equipped with the 'know how' of the subject. Since the activities of both these organizations are scattered in the different parts of the country, particularly in the case of ONGC, it is necessary to have Energy Coordinators in each activity center (project processing plant etc.). These energy officers should function exclusively for the energy conservation remaining purposefully detached from the problems of routine operations. (This should however not give the impression that these officers will not be constructively involved in project activities). In the existing system it is not very clear if the officer who is assigned with duty of information gathering has enough scope to collect the factual data of his concern. Further, the flow of information from such an officer to the regional energy cells/headquarter energy cell should necessarily remain unaltered. It is feared that such a system may permit concealing some vital information without which timely corrective actions may not be taken.

12.2.3 Training and Awareness Programmes

Efforts will be required for creating awareness amongst the working hands regarding the importance of energy conservation and the means and methods to achieve it. This could be brought about through workshops, physical demonstrations etc. An agency like PCRA/TERI could be asked to design specific programmes.

12.2.4 Energy Auditing

ONGC and OIL have got a fairly large number of installations which should be audited for energy consumption at-least once in a year. Such auditing to begin with would facilitate preparation of optimal data base and set up standards to enable improvements in energy consumption. It would also help in identifying vulnerable or loss prone areas warranting immediate attention. This activity, however, would call for auditing teams in large numbers to cover all the installations, which may not be an easy job. It is, therefore, suggested that certain specialized agencies like PCRA, NPC etc. could be requested to assist both in creating appropriate human base as well as determining the data base by carrying out the initial energy auditing exercises. It is noted that ONGC has carried out such exercise with their own efforts with the marginal assistance by PCRA but this was by no means enough to reach the desired level. The quantum of work involved is significantly higher and concerted efforts are required to be made in this area if conservation efforts have to yield concrete results in future.

12.2.5 Energy transition/switching to non-conventional energy source

It appears that scope exists for substitutions to non-conventional energy sources in many of the operations. Individual units such as rigs and platforms, production units etc. are basic consumers of energy. Involvement of the personnel working on these installations in the area of energy conservation only can suggest effective conversions. Association with agencies like Department of Non-conventional Energy Source (DNES) can be profitable. Of their own the two organizations have made some advancement in this direction utilizing solar and biomass energy sources for fuel and generation of electricity for heating and lighting.Diversification in power generation from natural gas and wind power generation can be taken up by the upstream petroleum sector in view of their profitable situation and incentives provided by the government in this regard.

12.2.6 Incentives

There has to be an inertia at least initially with operators in respect of energy conservation proposals. It may be necessary to remove it through encouragement and education. Healthy competitions between similar units of energy savings, for the same out put can be created by initiating awards. Recognition for new innovative steps in this direction can fetch considerable benefits. It is felt that in a number of cases induction of an energy efficient equipment, purposefully for energy conservation, or switch over to non-conventional energy systems like solar, photovoltaic source may entail such expenditures which the organizations may be reluctant to make. In order to overcome this kind of impediments fiscal incentives such as exemption from duty or providing financial subsidies may be required.

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